BeGaze 2.3 Manual

Version 2.3

May 2009

SMI
SensoMotoric Instruments

Table of Contents

Part I Introduction 2

Part II How to Read this Document 4

Part III Important Notice 6

Part IV Overview 8

1 Features and Benefits ... 8

2 General Product Information ... 11

BeGaze 2.3 Product Variants ... 11
Dongle Protection and License Update ... 12

3 How to Operate the Program ... 14

Basic Operation ... 14
Use Cases ... 17

4 Getting Started ... 20

Part V Experiment Setup 26

1 Create Experiment Wizard ... 26

Overview ... 26
Load Experiment from Folder ... 27
Experiment Name Tab ... 28
Gaze Data Tab ... 29
Stimulus Images Tab ... 32
Stimulus Association Tab ... 34
Event Detection Tab ... 35

2 Measurement Scenario ... 37

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3 Signal 37

4 Manage Experiments 39

Modify Experiment 39
Save Experiment 40
Open Experiment 40
Close Experiment 41
Experiment Backup 41
Experiment Restore 43
Delete Experiment 44

Part VI Experiment Analysis 46

1 Overview of Analysis Data View 46

2 Data View Selection 47

3 Data Views 49

Overview 49
Operating the data views 50
Stimulus Selection 51
Subjects 52
Subjects Selection 52
Subject-Trial Details 55
Events 57
Events Selection 57
Event Details 58
Player 61
Player Control 61
Playback Control 62
Zoom Control 63
Thumbnail Control 64
Thumbnail Control Context Menu 66
Chart Display Modes 67

4 AOI Editor 68

Overview 68

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Toolbar ... 70
Open AOI Editor and Select Stimulus ... 71
Create AOIs ... 71
Edit AOIs ... 73
Edit AOI Properties ... 79
Change AOI's Visibility ... 83
Navigate through Key Frames ... 85
Delete AOIs ... 86
Save and Load AOIs ... 87
AOI Format Description ... 87

5 Line Graph ... 93
Overview ... 93
Events List ... 94
Graph Area ... 96
Diagram Cursors ... 98
Data Table ... 98
Miniview ... 99
Settings ... 100

6 Scan Path ... 104
Overview ... 104
Main Data View ... 106
Settings ... 109
View Settings Dialog ... 109
Scan Path Tab ... 109
Cursor Tab ... 111
Fixations Tab ... 113

7 Attention Map ... 114
Overview ... 114
Main Data View ... 115
Settings ... 117

8 Key Performance Indicators ... 121
Overview ... 121
Main Data View ... 122
Settings ... 124

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9 AOI Sequence Chart 128
Overview 128
Main Data Tab 129

10 Binning Chart 132
Overview 132
Main Data Tab 133

11 Event and Reading Statistics 134
Overview 134
Selection Trees 135
Template List 137
Time Interval 139
Results Grid 140
Export Statistics 140
Event Statistics - Definitions and Examples 142
Reading Statistics - Definitions and Examples 168
Reading Statistics - References 182

Part VII Event Detection 187

1 Built-In Event Detector 187

2 Adjust Event Detection 188

3 Low Speed Event Detection 191

4 High Speed Event Detection 193

Part VIII Export and Conversions 197

1 Overview 197

2 Export Events 197
Export Events 197
Export File Format 200

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Export File Format ... 200
Header ... 200
Trial Section ... 201

3 Export Raw Data ... 204

Export Raw Data ... 204
Export Raw File Format ... 207
Export Raw File Format ... 207
Header ... 208
Trial Section ... 208

4 Video Files ... 210

Video Export ... 210
Optimizing AVI Videos ... 212
Converting Videos with SMI Video Optimizer ... 213
Background Information ... 216

Part IX Workspace Reference 218

1 Menu Commands ... 218

2 The Toolbar ... 221

3 Hotkeys Overview ... 222

Part X Appendix 227

1 About Box ... 227

2 Dongle - Installation and Troubleshooting ... 228

3 Experiment Types ... 229

4 Database ... 230

5 Requirements ... 230

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6 Limits 231

7 Program Installation 232

Part XI Copyright and Trademarks 235

Part XII License Agreement and Warranty 237

Part XIII About SMI 244

Index 246

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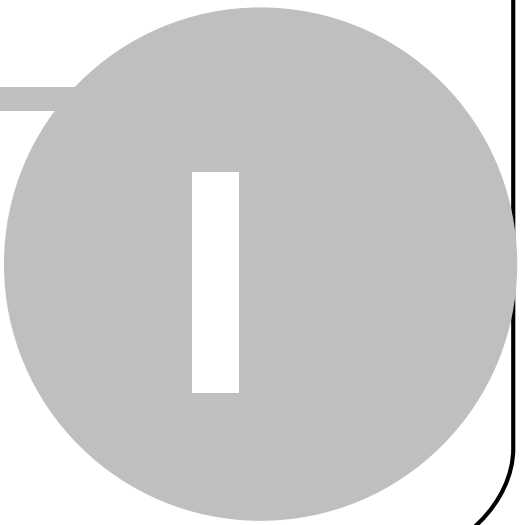
Introduction

Chapter



1 Introduction

Congratulations on your purchase of SMI BeGaze™ 2.3 behavioral and gaze analysis software for eye tracking data. SMI BeGaze™ 2.3 is designed particularly for researchers working in the fields of reading research, psychology, neurology, cognitive neuroscience, marketing research and usability testing.

Document number: 090526-P-1320-001-000-A

How to Read this Document

Chapter

2 How to Read this Document

This manual is designed to serve both as online help and as printed documentation of BeGaze 2.3.

Latest software versions covered in this document: BeGaze – Version 2.3

You can use this manual in one of these ways:

- Read through the chapters pertaining to particular functions to get background information before using the program.
- Consult the manual as a reference document to find out particular information. You can find a topic either by consulting the table of contents (at the front of the manual), or the index (at the end).

All the information in this manual can also be accessed through the program. Press F1 to get help on the menu-item or the element that has been currently selected.

If you cannot find what you are looking for try searching the index.

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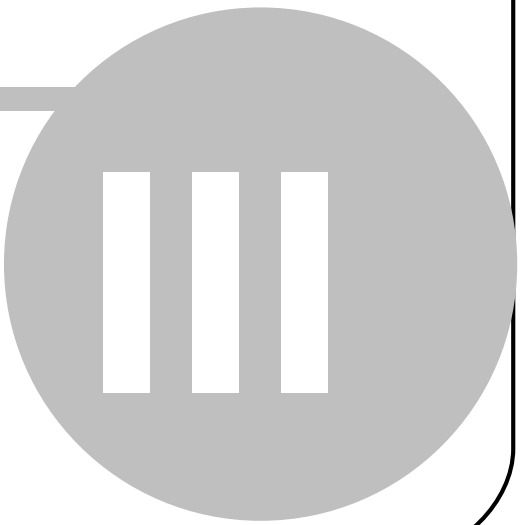
Important Notice

Chapter



3 Important Notice

Experiment Responsibility

Make sure the presented visual stimuli do not harm or injure your subjects.

SensoMotoric Instruments GmbH is in no way responsible for the experiments you develop, execute and analyze.

Do not offend against your subject's cultural background, age, psychological condition, or similar.

Photosensitive Epilepsy

Some people may have epileptic seizures triggered by light flashes or patterns.

This may occur while presented successive pictures or video material, even if they have never had a seizure before.

Supervise your subjects during experiments.

Stop immediately and consult a doctor if a subject has the following or similar symptoms:

- Involuntary movements
- Disorientation
- Convulsions
- Loss of awareness
- Altered vision

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Overview

Chapter

4 Overview

4.1 Features and Benefits

Meaningful results

The Behavioral and Gaze Analysis (SMI BeGaze™ 2.3) software simplifies monocular and binocular tracking data analysis by structuring the information on experiments and subjects, as well as displaying the results as meaningful graphs – all in one advanced application.

Simultaneous analysis

- Designed to support gaze sampling rates from 50Hz up to 1250Hz
- Processes both eye and head tracking data
- Stores all movement data, subject demographics and graphics in its internal database
- Analyzes several subjects or trials simultaneously
- Changes easily the parameters for reanalyzing previous data

Various Stimuli

SMI BeGaze™ 2.3 displays, analyses and visualizes various kind of stimuli - whether

- text and graphics
- still images
- video clips
- websites

SMI BeGaze™ 2.3 analysis does not limit the choice of stimulus for experiments.

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Multiple Subjects

- Designed to handle multiple subjects
- Integrated filter functions allow analysing subgroups of subjects within trials based on user assigned parameters (e.g. gender, age, etc.)

Smart Visualizations

SMI BeGaze™ 2.3 provides the full spectrum of visualizations for

- Key performance indicators - the visual executive summary
- Gaze plots (scan path, bee swarm)
- Attention maps (focus map, heat map)
- Real time statistics (key performance indicators)
- Visualization parameters can be modified "on-the-fly"
- Visualizations can be exported as video (AVI) or bitmap for documentation, presentation etc.

Exploit Optimized Workflow and Interaction

SMI BeGaze™ 2.3 is not only the tool for visualization of gaze interaction with stimuli. It is also a tool to optimize workflow when it comes to quantitative analysis.

- Drill into fixation and saccade event data from scanpath or linegraph
- Find point of regard by time interval of events
- Click on data plot to view detailed information and statistics of selected events
- Customize diagrams and statistical data tables before exporting to file,
- Define your personal visualization standards and apply them across analyses or experiments etc.

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AREAS OF INTEREST (AOI) – static and dynamic

- The integrated AOI editor allows definition of zones of interest
- Various geometries can be fitted to the element of interest
- Automatic Move&Morph™ function for dynamic stimuli e.g. video clips ensures the AOI being “on target” even in position and form changing elements of interest
- AOI statistics can be visualized as AOI sequence per subject, or AOI Binning Chart for groups of subjects
- The AOIs can be displayed together with gaze plot or attention map visualization
- Geometric definition of AOIs can be saved to, and loaded from file – e.g. for recurring experiments with same stimuli

Statistical Data – Your way to quantitative Analysis

- Powerful statistics module allows configuration and export of statistical data tables of more than 100 statistical variables (e.g. first fixation duration, number of glances, pupils size, blink frequencies etc.)
- Export AOI transition matrix for single or multiple subject analysis
- Export fixation and saccade parameters to file
- Measure saccade latencies and reaction times in Linegraph diagram
- Adjust event detection parameters as needed

Intelligent integration

- SMI BeGaze™ 2.3 fully integrates with SMI Experiment Center™ - the software to make gaze tracking experiments and visual stimuli creation a snap
- Load all experiment data into SMI BeGaze™ 2.3 by 1-click: Fail-safe, fast, convenient

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- SMI BeGaze™ 2.3 offers an experiment creation wizard to load manually the experiment data, allow to assign attributes to the subjects for later grouping and filtering
- Assignment of stimulus sand subject ‘s gaze data is done manually or automatically

4.2 General Product Information

4.2.1 BeGaze 2.3 Product Variants

BeGaze 2.3 is distributed in various variants that are customized to the variety of research needs.

- The BeGaze 2.3 **Light** version is delivered with the iView X™ system together with the SMI Experiment Center™ 2 Light software. BeGaze 2.3 allows to analyze experiments with two subjects and five still image stimuli and predefined video examples.

- The BeGaze 2.3 **Professional** version offers the full range of program features to analyze and export eye tracking data for still images stimuli, without any restrictions concerning the number of subjects or stimuli.
- The **Video** extension supports video stimuli in addition to still images stimuli.
- The **Reading Package** extension adds detailed statistics for reading experiments.
- The **Observation Package** extension adds the User video and User audio playback.

- The BeGaze 2.3 **Video** version offers the same range of features as the BeGaze 2.3 **Professional** version especially for video stimuli but without still image stimuli support.

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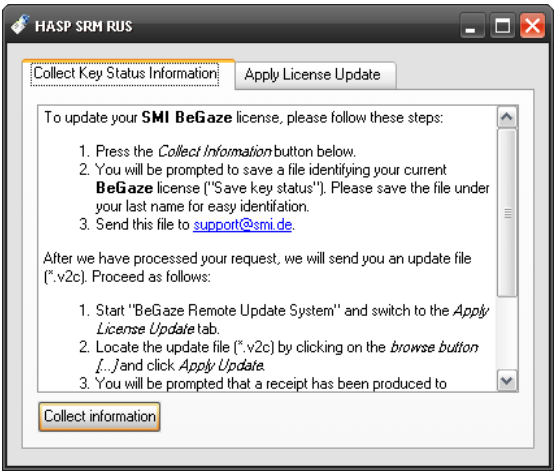
4.2.2 Dongle Protection and License Update

BeGaze 2.3 is dongle-protected and requires a license. If you want to update your BeGaze 2.3 version, please contact the SMI sales department 244 to obtain a new license.

Collect license information

The SMI sales department will need your current license information:

1. From the Windows™ start menu, select **Programs: SMI: Experiment Suite 360° Remote Update Utility**.
2. In the **Collect Key Status Information** tab of the Remote Update Utility, click the **Collect information** button. This will acquire the current license information which is currently stored on the dongle device.


HASP SRM RUS
Collect Key Status Information
Apply License Update
To update your SMI BeGaze license, please follow these steps:
1. Press the Collect Information button below.
2. You will be prompted to save a file identifying your current BeGaze license ("Save key status"). Please save the file under your last name for easy identifation.
3. Send this file to support@smi.de.
After we have processed your request, we will send you an update file (*.v2c). Proceed as follows:
1. Start "BeGaze Remote Update System" and switch to the Apply License Update tab.
2. Locate the update file (*.v2c) by clicking on the browse button [...] and click Apply Update.
3. You will be prompted that a receipt has been produced to
Collect information

3. You will be prompted to save a file identifying your current BeGaze 2.3 license ("Save key status"). Please save the file under your last name for easy identification.

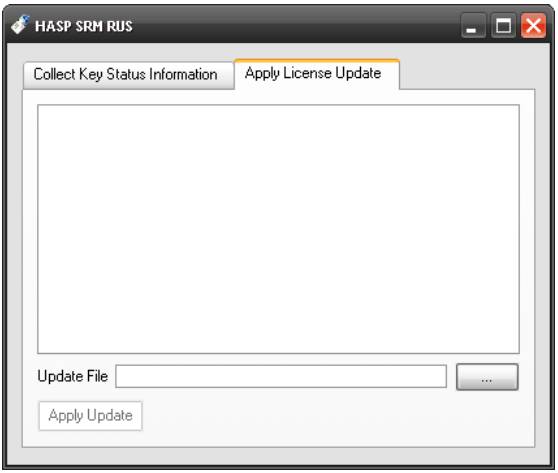
4. Send this file to sales@smi.de.

   You will receive a new license key from SMI.

Update license

After you have purchased your new license key (*.v2c file format), update your license as follows:

1. From the Windows™ start menu, select **Programs: SMI: Experiment Suite 360° Remote Update Utility**.
2. Switch to the **Apply License Update tab**.



Ensure that only the BeGaze 2.3 dongle is plugged. Remove all other dongles from the PC.

3. Locate the update file (*.v2c) by clicking on the browse button ... and click **Apply Update**. This will write the updated license information to the dongle device.
4. You will be prompted that a receipt has been produced to confirm the update. Please send this receipt file to sales@smi.de.
5. Close the **Remote Update Utility** and start BeGaze 2.3. You can view

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detailed licensing information in the BeGaze 2.3 About Box 227.

Type and status of your licenses are stored on the dongle device, not on the PC on which BeGaze 2.3 is installed. With the license update procedure, the dongle is updated. That means, that you can run BeGaze 2.3 on any PC when the dongle is plugged in.

4.3 How to Operate the Program

4.3.1 Basic Operation

In BeGaze 2.3 you process the measurement data with the following steps:

1. Collect and assemble all data which belong to one experiment.
2. Select an analysis, its data sources (stimulus, subjects, time interval).
3. Modify single or multiple dimensions of the data source to adapt the analysis.
4. Role over a selection of data sources to the next analysis for a different perspective or drill down.
5. Evaluate, export and/or print diagrams or data.

Data collection and experiment structure

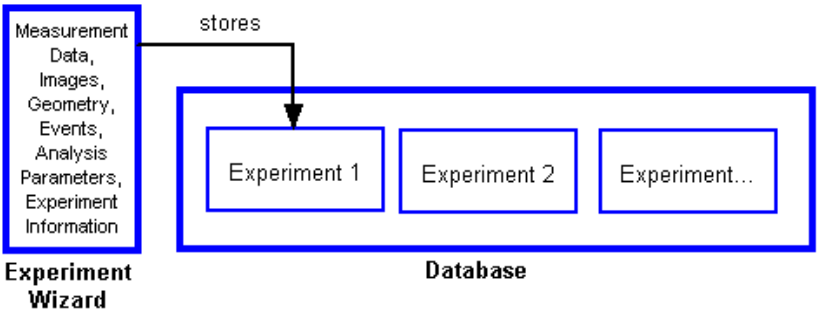
In a typical eye tracking *Experiment*, a number of subjects are presented with a certain stimulus. For each subject a data file is recorded which is called a *Run*. In order to synchronize the measurement data with changes in stimulus presentation, the data files contain either a *Trial Number* or a *User Message* at the onset time of the stimulus change. This synchronizing information can be used to separate each run into *Trials*, where each trial is associated with a certain stimulus image. So a typical BeGaze 2.3 experiment has the following structure:

Experiment

- Run 1 (a measurement data file)
  - Trial 1 (associated with a certain stimulus image)
  - Trial 2
  - Trial [...]
- Run 2
  - Trial 1
  - Trial [...]
- Run [...]

A BeGaze 2.3 experiment is a data collection which consists of one or several measurement data files (runs), a number of stimulus images and some additional information you have to provide.

The BeGaze 2.3 experiment is assembled with the Create Experiment wizard 26 and is stored into a database 230, which may consist of a number of different experiments.



Combine stimulus images with the data

The **Create Experiment** wizard has automatically combined the stimulus images with the data.

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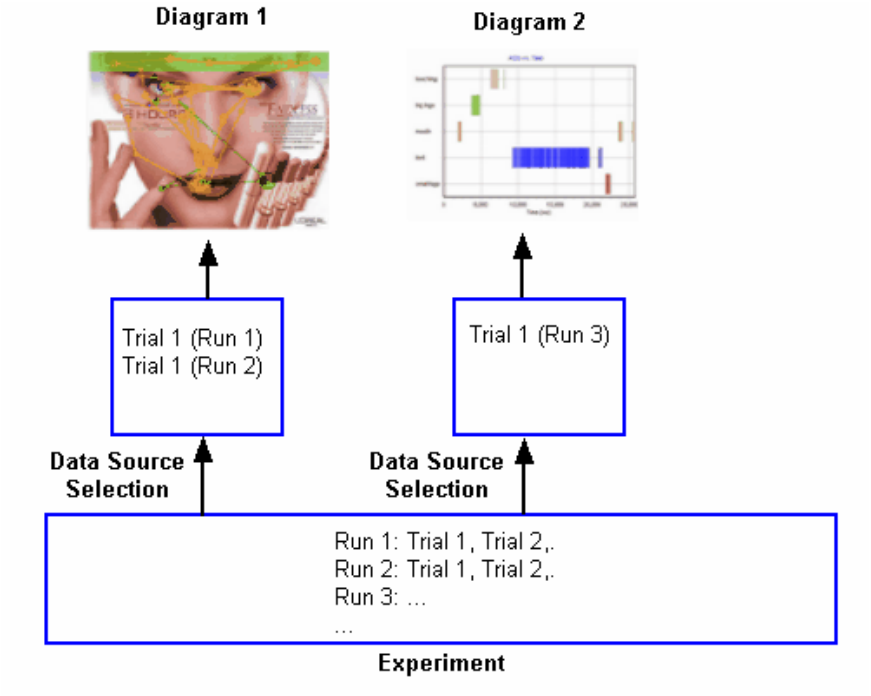
Select a diagram and its data sources

After the experiment has been created, you can select the desired diagram 47 and choose the trials from the experiment that should be displayed.



Export and print the diagram

Finally you can export 197 the data to a text file or print the diagram.

4.3.2 Use Cases

BeGaze 2.3 can be used in a broad range of eye tracking data analyzing contexts but there are typical use cases. To get familiar with the powerful features of the program, it will be helpful to know some standard use cases.

Advertising

This use case includes the evaluation of still images (e.g. print ads) or video material (e.g. television commercials) which are presented to the subjects using the SMI Experiment Center. With this use case, you present the same visual stimuli to a larger group of subjects.

- Prerequisites:

  – min. versions for still images: iView X 2.0.23 and Experiment Center 2.0

  – min. versions for videos: iView X 2.1.16 and Experiment Center 2.1

- Experiment design: Experiment Center is used to create and record the experiment. The experiment includes various stimuli, such as videos, still images, and text.

  – Typical image presentation: Images (BMP, JPG, PNG) up to 1280x1024 pixels

  – Typical video presentation: Videos (AVI) with 30 to 300 seconds in length and a typical video size of 320x200, 640x480, or 720x576 pixels

- Experiment recording:

  – Use a proper gaze tracking device (RED, Hi-Speed, or MRI/MEG).

  – During the experiment, the data set is stored in the experiment's results folder. The data set includes the presented stimuli as well as the IDF files (gaze tracking data and user events), the subject protocols, and the meta data (subject properties, experiment design).

- Typical evaluation: The analysis of this common use case is described step-by-step in the Getting Started 20 topic.

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Web Testing

Another use case is to evaluate web page perception and/or user navigation during web browsing sessions. This use case features the presentation of web pages to a group of subjects using the SMI Experiment Center. To evaluate the user navigation, Experiment Center provides screen recording of all actions the subjects perform during the web browsing session.

- Prerequisites: min. version is iView X 2.1.16 and Experiment Center 2.1
- Experiment design: Experiment Center is used to create the experiment and to record the subjects' web site perception and/or navigation within the site.

  – Use **Full Website** mode to store the web page as one large picture with automatic scroll compensation

  – Record keystrokes and mouse clicks

  – Optionally, use the screen recording feature to record the user actions.

- Experiment recording:

  – Use a proper gaze tracking device (RED, Hi-Speed, or MRI/MEG).

  – During the experiment, the data set is stored in the experiment's results folder. The data set includes either as a series of still images representing full web pages, or screen shots of landing pages, and (optional) background screen recordings. In the results folder, the IDF files (gaze tracking data and user events), the subject protocols, and the meta data (subject properties, experiment design) are stored also.

- Typical evaluation: Open the experiment in BeGaze 2.3 by using the Load Experiment from Folder 27 command. Evaluate the experiment together with the recorded mouse clicks and key presses (which BeGaze 2.3 indicates as **User Messages**) with the Scan Path 104, Attention Map 114, and AOI statistics data views (Key Performance Indicators 121, AOI Sequence Chart 128 and Binning Chart 132).

Software Usability

A third use case is to monitor subjects with the objective to improve software usability. For this, a group of subjects is working with a software program while their gaze tracking data and their user actions are recorded to individual videos.

- Prerequisites: min. version: iView X 2.1.16, Experiment Center 2.1
- Experiment design: Experiment Center is used to create the experiment and to record the subjects' actions (mouse clicks and key presses). For each subject, an individual video is recorded.
  - Typical video length: 60 to 300 seconds
  - Typical video size: 1280x1024 pixels
- Experiment recording:
  - Use a proper gaze tracking device (RED, Hi-Speed, or MRI/MEG).
  - During the experiment, the data set is stored in the experiment's results folder. This includes the recorded videos as well as the IDF files (gaze tracking data and user events), the subject protocols, and the meta data (subject properties, experiment design).
- Typical evaluation: Open the experiment in BeGaze 2.3 by using the Load Experiment from Folder 27 command. Analyze the videos together with the recorded user actions, such as mouse clicks and key presses (which BeGaze 2.3 indicates as **User Messages**) with the Scan Path 104, Attention Map 114, and AOI statistics data view (Key Performance Indicators 121, AOI Sequence Chart 128 and Binning Chart 132).

HED Videos

Another use case is to record individual in-the-field videos while monitoring the subjects gaze position. A single subject is monitored, for example while visiting a supermarket, doing sports, or driving a car.

- Prerequisites: min. iView X 2.1
- Experiment design: For each subject, an individual real-world video is

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recorded.

- Experiment recording:

  – Use the SMI Head mounted eye tracking device for real-world eye tracking studies.

  – Typical video length: 10 to 60 minutes

  – Typical video size: 752x480 pixels

- Typical evaluation: Use the BeGaze 2.3 analysis data view (Scan Path 104 and Attention Map 114) and AOI statistics data view (Key Performance Indicators 121, AOI Sequence Chart 128 and Binning Chart 132) to analyze the recorded video data.

4.4 Getting Started

The following steps describe how to analyze a typical **Advertising** experiment (see Use Cases 17) recorded using SMI Experiment Center. If you start BeGaze 2.3 for the first time, you may proceed as described below. Alternatively, you can open one of the provided sample experiments (see Open Experiment 40).

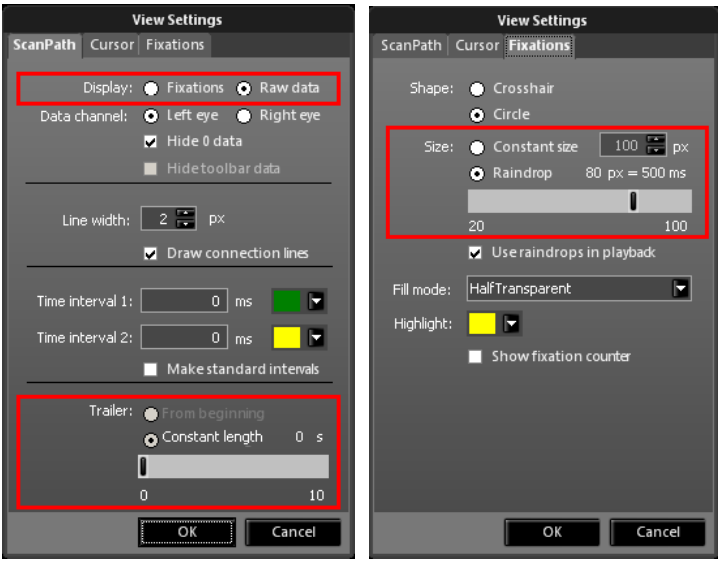
1. Create a BeGaze 2.3 experiment directly from the Experiment Center's results folder (see Load Experiment from Folder 27).
2. Open the **Scan Path** plug-in (see Scan Path Overview 104).

   – Select a stimulus (see Stimulus Selection 51).

   – Select subjects, either manual or based on a subject property filter (see Subjects Selection 52).

   – Modify the **Scan Path** settings (see View Settings Dialog 109). For video stimuli, you may configure the "bee swarm" mode. Therefore, change the **Display** setting to **Raw Data** with the **Trailer** switched to **Constant Length** and the length slider set to zero (left image). For still image stimuli, you may change the **Display** setting to **Fixations** with the **Trailer** switched to **From Beginning**. When displaying **Fixations**, you should open the **Fixations** tab and change the **Size** of

fixation circles (right picture).



– Use the Player Control [61] to play the scan path presentation. To move to a specific event, use the **Events** view (see Events Selection [57]).

– Export the data – either to a picture or to a video (see Export Overview [197]).

3. Now open the **Attention Map** data view to display the **Focus map** (see Attention Map Overview [114]).

   – The **Attention Map** data view inherits the settings of the previously opened **Scan Path** data view. If appropriate, change the stimulus selection and the subjects selection (see above).

   – Modify the **View Settings** (see Attention Map Settings [117]). For video stimuli, select either the **Heat Map** or the **Focus Map** setting. For still image stimuli, select either the **Heat Map** or the **Focus Map** setting and change the visible area with the **Kernel Width** slider. Change the **Trailer** setting to **From Beginning** to see how the AOIs have evolved over time.

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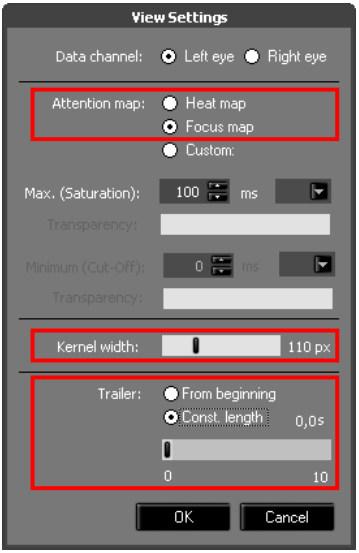

– Use the Player Control [61] to play the attention map presentation. To move to a specific event, use the **Events** view (see Events Selection [57]).

– Export the data – either to a picture or to a video (see Export Overview [197]).

4. Open the **AOI Editor** data view (see AOI Editor Overview [68]). This data view allows you to define **A**reas **O**f **I**nterest (AOIs). An AOI defines an image area you are interested in. AOIs are painted on top of an object in a video or image. If the subjects gaze position hits the defined area, this is evaluated as an "AOI hit". You need to define AOIs in order to use the subsequent data views (**AOI Sequence Chart** or **Binning Chart**).

   – Select a stimulus (see Stimulus Selection [51]).

   – If you have selected a video stimulus, move forward to the position in the video where you want to start with an AOI (see Player Control [61]).

   – Select an AOI type: rectangle, polygon, or circle and paint it on the object (see AOI Editor Toolbar [70]). To toggle the visibility of an AOI,

press the [V] key. For a video stimulus, use the left and right arrow keys to move within the video. Use the mouse to change the position of the AOI. Note, that AOI key frames are generated when size, position or visibility changes, while the interpolation between key frames is done automatically (tweening). For still image stimuli, AOIs are always fixed and valid for the whole selected time period.

– Rename the AOI if necessary (see Rename AOI 74).

– Add more AOIs as required.

5. Open the **Key Performance Indicators** data view (see Key Performance Indicators Overview 121). This data view shows relevant statistical indicators for the defined AOIs.

   – Modify the **View Settings** (see Key Performance Indicators Settings 124) to select the desired indicators and the font size used for the display.

   – Select the desired subjects, either manual or based on a subject property filter (see Subjects Selection 52).

   – Select the **Save Image to File...** command from the **Export** menu to export the current visualization as a picture.

6. Open the **AOI Sequence Chart** data view (see AOI Sequence Chart Overview 128). This data view shows the correlation between subject and AOI hits.

   – Modify the settings available in the bottom view (see Chart Display Modes 67). It is recommended to select **Raw data** for video stimuli and **Fixations** for still image stimuli.

   – Select the desired subjects, either manual or based on a subject property filter (see Subjects Selection 52).

   – Select the **Save Image to File...** command from the **Export** menu to export the current visualization as a picture.

7. Open the **Binning Chart** data view (see Binning Chart Overview 132). This data view shows a statistical overview of AOI hits for separated time slices (bins).

   – Select a stimulus (see Stimulus Selection 51).

   – Select the desired subjects, either manual or based on a subject

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property filter (see Subjects Selection 52).

– Modify the settings available in the bottom view (see Chart Display Modes 67). It is recommended to select **Raw data** for video stimuli and **Fixations** for still image stimuli. Modify the **Bins integration time** to your needs.

– Select the **Save Image to File...** command from the **Export** menu to export the current visualization as a picture.

Further steps depend on your requirements. For example, you may

- use other data views (see Overview of Analysis data views 46),
- export data to CSV files (see Export data to files 197),
- print or save images of the currently opened diagram (see Export menu commands 218), or
- backup your experiment (see Backup 41).

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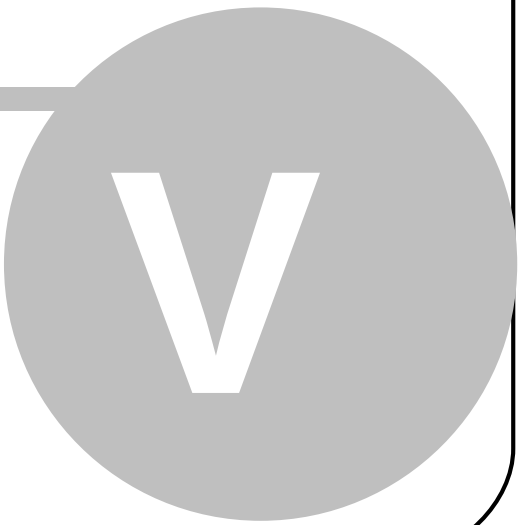
Experiment Setup

Chapter



5 Experiment Setup

5.1 Create Experiment Wizard

5.1.1 Overview

With the **Create Experiment** wizard you assemble all data to be analyzed to a BeGaze 2.3 experiment (see Basic Operation 14). There are two ways to do so.

Load experiment from folder

You can load a results folder which has been stored with the SMI Experiment Center to BeGaze 2.3 and thus easily create your experiment (see Load Experiment from Folder 27).

Create experiment step-by-step

Alternatively, you can create a new experiment step-by-step.

1. Click on the icon in the toolbar 221 or go to the **File** menu and select **New Experiment**.

   The **Create experiment** dialog opens with several tabs.

2. You can proceed through the tabs step by step using the **< Back** and **Next >** buttons. You can also immediately jump to a specific tab by clicking on the tab title.

3. Fill in the experiment data in the following tabs:

   Experiment Name 28: Experiment name and additional experiment information can be entered here.

   Gaze Data 29: Here you select the eye tracker data files to be analyzed, if needed the plane file is selected in this tab.

   Stimulus Images 32: All images for one experiment need to be selected in this tab.

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Stimulus Association 34: Based on the experiment type the selected stimuli need to be associated with the trials or planes of the experiment.

Event Detection 188: The parameters for the fixation/saccade detection can be changed in this tab.

Note that the Create experiment button is enabled only if the experiment contains sufficient data to perform the analysis.

5.1.2 Load Experiment from Folder

You can easily create an experiment based on the data generated with the SMI Experiment Center. The stored gaze tracking data will be processed to BeGaze 2.3. During this process the stored meta data such as subject properties and the properties of the presented stimuli will be parsed and the experiment will then be created automatically in BeGaze 2.3.

Load experiment from folder

1. Select **New Experiment from Folder** from the **File** menu.

   A file selection dialog opens where you can browse for the directory corresponding to the folder you want to load.

2. Select the appropriate folder from the directories list.
3. The Create Experiment dialog opens.
4. Adjust the settings in the Event Detection 188 tab and other tabs, if necessary.
5. Click on **Create Experiment**.

   A process bar indicates the creation of the experiment. The completion of the process is confirmed with a message box.

6. Confirm with **OK**.

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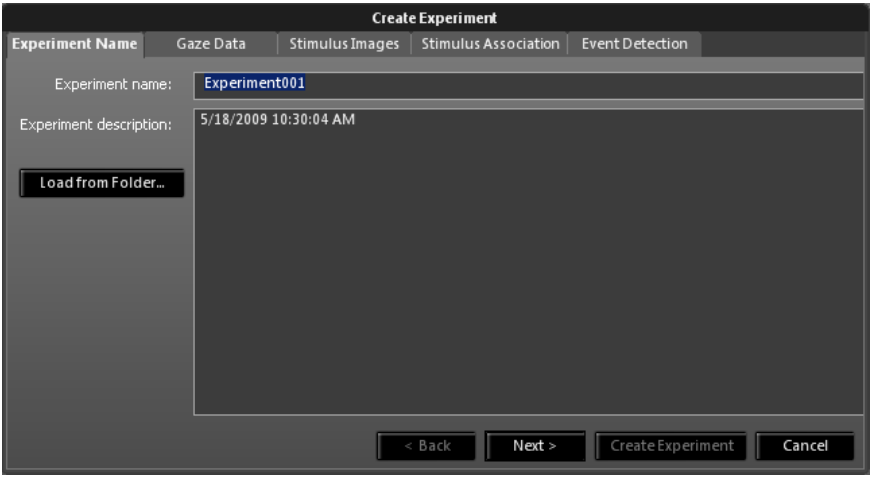
To load an experiment from folder, you can alternatively use the Load from Folder command which is located in the Experiment Name tab of the Create Experiment 26 dialog.

5.1.3 Experiment Name Tab

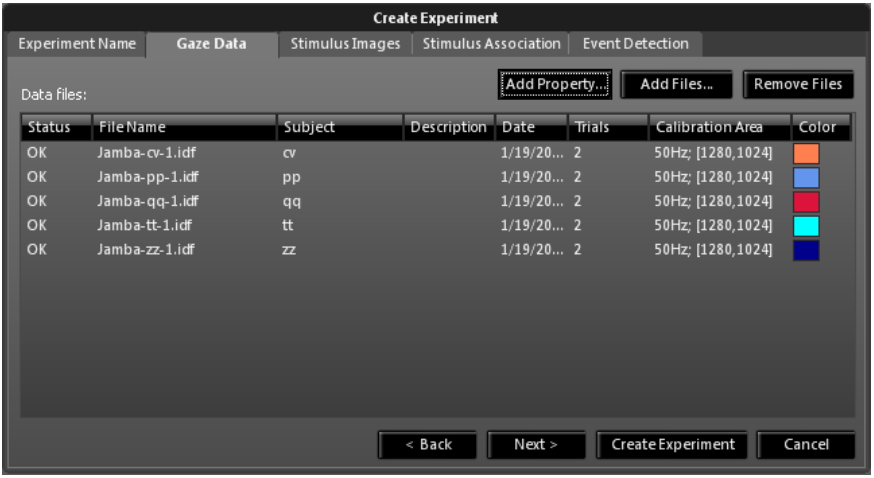
In this tab you can enter general information for the experiment. The experiment will be saved in the database 230 with the chosen name and description.

The **Load from Folder** command allows you to automatically fill the data and to create the experiment (see Load Experiment from Folder 27).



5.1.4 Gaze Data Tab

In this tab you select which eye tracker data files should be analyzed.



Select files

BeGaze 2.3 currently supports the iView X data files (*.idf) .

a) If you click on **Add Files...**, a file selection dialog opens. Select one or more files for the experiment.

b) To remove a file from the list, select the file and click on **Remove Files**.

Multi-Frequency support: IDF files recorded with different sampling rates are allowed in the same experiment.

Add or modify subject properties

You can define individual subject ”group” parameters for the experiment.

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These parameters are entered as subject properties and serve as additional information to your experiment. Useful properties may be ”Age” and ”Gender”. The first property is already defined as the subject's **Color** and can be changed at this point or later.

Subject properties are taken automatically from results generated with the SMI Experiment Center (see also Load Experiment from Folder 27). You can modify the properties in BeGaze 2.3 as described below.

To add new subject properties proceed as follows:

1. Click on **Add Property**.

   The **Add Experiment Property** dialog opens.

2. Enter a property name, e.g. ”Gender”.
3. Optionally, you can enter a default value.
4. Click **OK** to confirm your entry.

   The new property will be inserted in the gaze data table. If you didn’t enter a default value for the property, you can now enter a value for a selected table entry.

5. Select an entry and enter a value in the property column. If you want to change the value, simply overwrite it.

Properties can also be directly edited in the scan path 104, attention map 114, key performance indicators 121, aoi sequence chart 128 or binning chart 132 data view when you click on the property.

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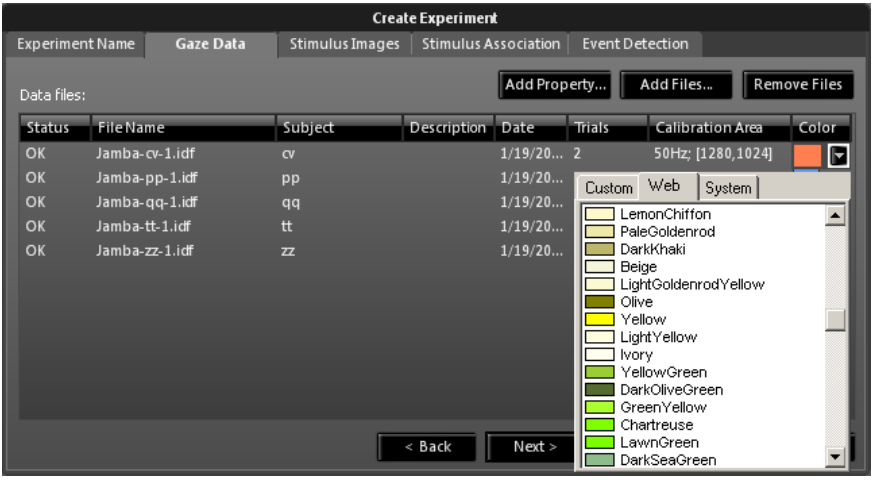
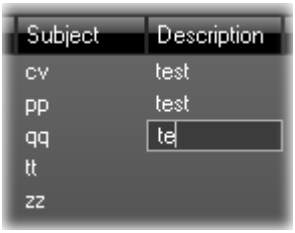


Information on file entries in the data files table

- **Status**: In order to be analyzed together, all files must be recorded under the same conditions. The file to be first in the list serves as reference. All other files must fit to the reference file. If a file in the list fits the criteria, its status is ok. If a file is rejected, the status will inform of the reason of rejection and the color of the row will be red.
- **File Name** and **Date**: In these columns the file name and date are displayed.
- **Subject** and **Description**: If the files contain subject and description information they will be listed here. In this tab, they can be edited with a single click of the mouse.



- **Trials**: The number of trials in the file are computed and shown in this

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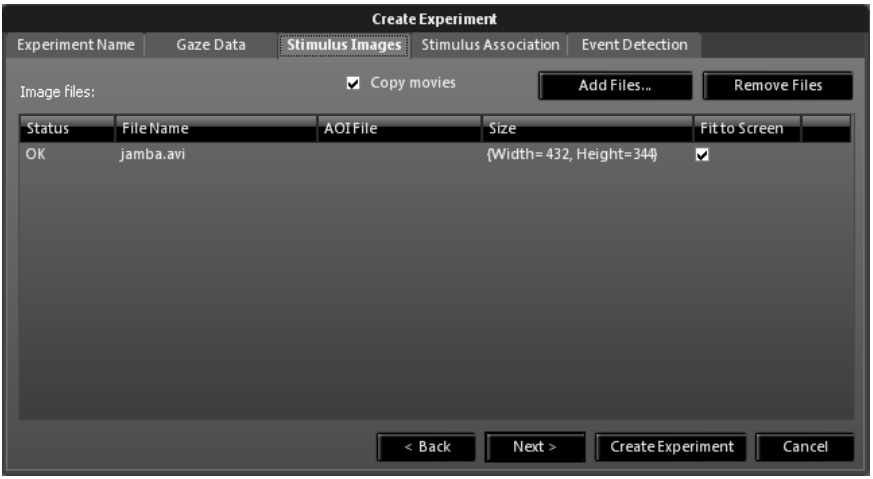
column.

- **Calibration Area**: Sample rate and calibration area size are presented in this column.
- **Plane file**: If the data files used require a plane stimulus file, then a **Select Plane File** button will be shown on the tab.

The planes description file comes from the Surveyor. The measurement scenario 37 is determined by the number of planes in the selected file.

5.1.5 Stimulus Images Tab

All required stimulus images for an experiment need to be selected in this tab.



Copy movies (only for video files)

The **Copy movies** check box is checked by default. This effects that the

video files used in the experiment are copied to the database 230.

Note that this may cause a high data volume in the database directory. If you backup an experiment 41, the video data will be stored in the database even if the **Copy movies** check box has been deactivated during the experiment analysis.

Warning: When the **Copy movies** check box is deactivated, videos are taken from their original location. If video files are deleted or moved, the experiment cannot be loaded any more.

Select files

a) If you click on **Add Files...**, a file selection dialog will open. Select one or more files for the experiment.

b) To remove a file from the list, select the file and click on **Remove Files**.

Information on file entries in the image files table

- **Status**: To be analyzed together, each stimulus has to meet the following criteria:

  – The format of an image file must be of type: bmp, jpg, jpeg, png.

  – The format of a video file must be of type avi and optimized with the XMP4 encoder provided in the installer (incompatible videos can be optimized with the Video Optimizer tool provided in the package)

  – The image size must be at least as large as the calibration area of the reference data, which is the first data file in the gaze data file list 29.

  If the stimulus fits the criteria, the status is ok. If the stimulus fails, the status will give a clue about the reason of failure and the color of the row will be red.

- **Fit to Screen** (video only): Activate this check box, if the stimulus was presented to the subject in full screen mode (for example in an experiment which was performed with the SMI Experiment Center). This assures that the overlaying gaze data are displayed and analyzed

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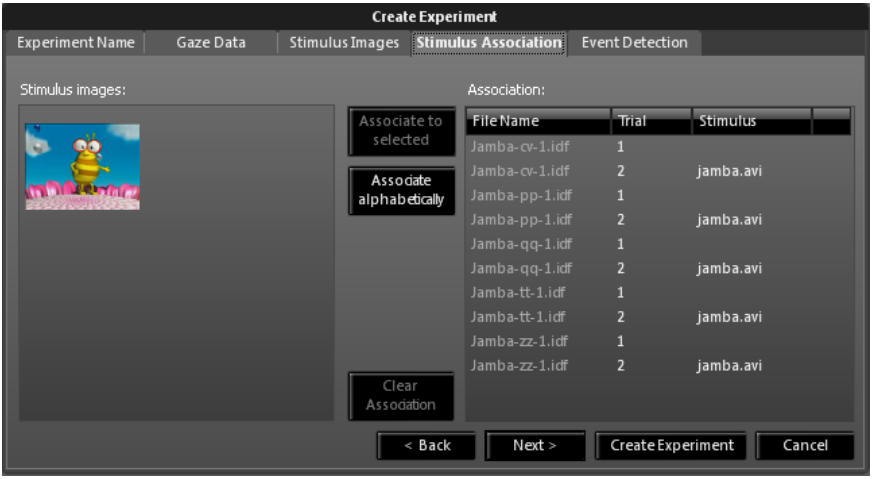
correctly in BeGaze 2.3.

- **AOI File**: Images and Videos can be associated with AOI files. The AOI files should have the .xml extension (see also AOI Format Description 87) and be located in the same folder as the images. If an AOI file has the same name as an image file, except for the extension, it will be automatically added to the experiment and listed in the **AOI Files** column next to the respective image file.

5.1.6 Stimulus Association Tab

In this tab you can associate each trial (or plane in the case of a multiple plane Measurement Scenario 37) with a stimulus image, that will be used as background for the single views. It is recommended to set suitable associations between stimulus images and trials at an early stage of the analysis process, as it will allow an easy handling with the experiment data later on.



It's not required to make the associations. Items that have no stimulus associated will get a default gray image as background.

In the left part of the window all stimulus images of the experiment are displayed in an image pool. In the right part all trials (or planes) are listed in the **Association** list. If the trials are separated by trial separator messages 37, every trial should already be associated with the appropriate stimulus image. Otherwise, the stimulus images will be sorted and associated with the trials in alphanumerical order.

Associate a stimulus image

1. Click the image you want to associate.
2. Click the trial (or plane) you want to associate.
3. Click the **Associate to selected** button.

You can also associate stimulus images with the following actions:

a) If a trial is selected then you can simply double-clink the image you want associated with it.

b) To clear an association, select a trial and use the **Clear Association** button.

c) All actions that can be done on one trial, can be done on multiple trials by selecting multiple trials in the trials list.

d) With the **Associate alphabetically** button, all associations are redone by associating images to all trials in alphabetical order.

5.1.7 Event Detection Tab

In this tab you can adjust the event detection parameters for the trials loaded within the experiment. You can also adjust these settings during analysis. For information on the event detection parameters, see Adjust Event Detection 188.

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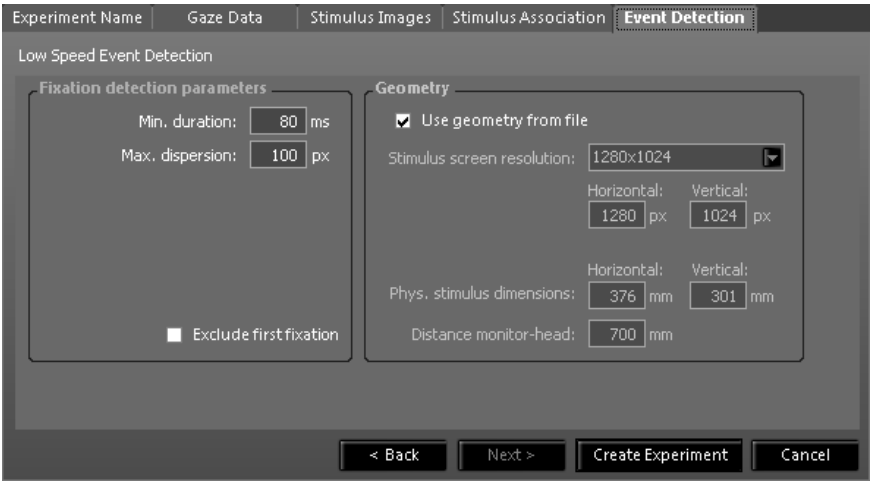
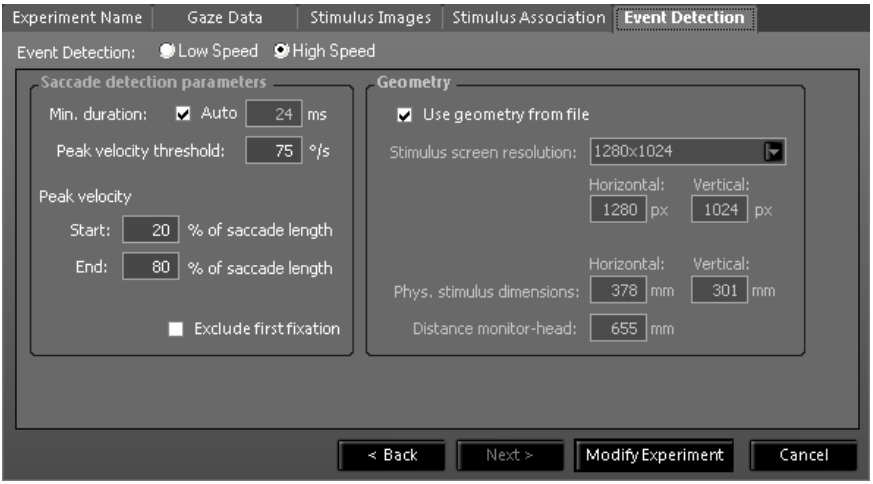
Low - Speed data (<200Hz):



High- Speed data (>=200Hz) with selectable event detection algorithms, either low speed or hi-speed algorithm:



5.2 Measurement Scenario

There are three scenarios that BeGaze 2.3 can handle:

Non Head Tracking survey:

No head tracking system was used and the raw data is mapped directly on the selected stimulus.

Single Plane survey:

Only one plane is surveyed. All measurements are performed on one single plane. The raw data is mapped on the surveyed plane. The contents of the plane may change during the experiment. Possible use case: subjects reads a newspaper.

Multiple Plane survey:

Several planes are surveyed. Each plane has a fixed content, that does not change during the experiment. The raw data is mapped to it's associated plane. Possible use case: subject sits in a cockpit and watches the various panels.

5.3 Signal

Data Trial Separator

For a better overview each BeGaze 2.3 experiment run is separated into *Trials* (see Basic Operation 14). The separation is performed automatically by ”Trial Number” or by ”Trial Separator Message”, according to the recorded data.

The trial number and/or trial separator message was recorded by the eye tracker together with the data. Note, that iView X allows both trial number and trial separator message recording. If trial separator messages are present, BeGaze 2.3 automatically performs the separation by trial

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separator message. Otherwise, the trial number separation is used.

Separation by trial number: If you use a trial number you have to set associations 34 between stimulus image and trials manually.

Separation by trial separator message: If you use an trial separator message it must have a specific format:

<Timestamp>MSG# Message: <image name>

Example:

28437864110MSG# Message: image01.bmp

This allows an automatic association 34 between stimulus images and trials. The following image and video formats are supported: bmp, jpg, jpeg, png, avi.

The separator message can be inserted in the IDF file during recording by sending the remote command ET_REM to iViewX. The format has to be:

ET_REM "filename.suffix"

Example:

ET_REM "image01.bmp"

Auxiliary Events

You can choose if *Trigger Events* should be created by *Trigger Message*. If so, the trigger message must have a specific format:

<Timestamp>MSG# Message: TRG: <trigger message>

Example:

28437864110MSG# Message: TRG: left Button up

The trigger message can be inserted in the IDF file during recording by sending the remote command ET_REM to iViewX. The format has to be:

ET_REM "TRG:<trigger message>"

Example:

ET_REM "TRG: left Button up"

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5.4 Manage Experiments

5.4.1 Modify Experiment

With the **Modify Experiment** wizard you modify the data to be analyzed in the current experiment.

1. From the **File** menu, select the **Modify Experiment** command.

   A dialog opens with several tabs.

2. You can proceed through the tabs step by step using the **< Back** and **Next >** buttons. You can also immediately jump to a specific tab by clicking on the tab title.

3. Fill in the experiment data in the following tabs:

   Experiment Name 28: Experiment name and additional experiment information can be entered here.

   Gaze Data 29: Here you can select the new eye tracker data files to be analyzed, and also remove from the data base the existing data. The existing data will be removed permanently. You can also add new subject properties or modify the content of existing subject properties.

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Stimulus Images 32: Here you can add new stimuli and also remove existing stimuli from the data base. The existing stimuli will be removed permanently.

Stimulus Association 34: Based on the experiment type the selected stimuli need to be (re)associated with the trials or planes of the Experiment.

Event Detection 188: The parameters for the fixation/saccade detection can be changed in this tab.

Note that the Modify Experiment button is enabled only if the experiment contains sufficient data to perform the analysis.

5.4.2 Save Experiment

To save an experiment proceed as follows:

1. Click on the icon in the toolbar 221 or go to the File menu and select **Save Experiment**.
2. To save the experiment to a new name, click **Save Experiment As**. Enter a new name and click **Save**.

   The experiment will be saved with it's current settings, for example the opened data views, in the database 230 directory.

5.4.3 Open Experiment

To open an experiment proceed as follows:

1. Click on the icon in the toolbar 221 or go to the **File** menu and select **Open Experiment**.
2. The **Open Experiment** dialog opens.
3. Select the experiment you want to open.

4. Click **Ok**.

5.4.4 Close Experiment

You can interrupt the creation and analysis of an experiment by closing it. To close an experiment proceed as follows:

1. From the **File** menu, select the **Close Experiment** command.
2. Click **Save** if you want to save the experiment with it's current settings, for example the opened data views. Otherwise click **Don't Save**.
3. To continue the experiment, simply open 40 it again.

5.4.5 Experiment Backup

You can backup a saved experiment to a file. To backup an experiment proceed as follows:

1. Close 41 all experiments.
2. From the **File** menu, select the **Backup Experiment to File** command.

The Backup Experiment to File command can be performed only if all experiments are closed.

The **Select Experiment** dialog opens.

3. Select the experiment you want to backup.

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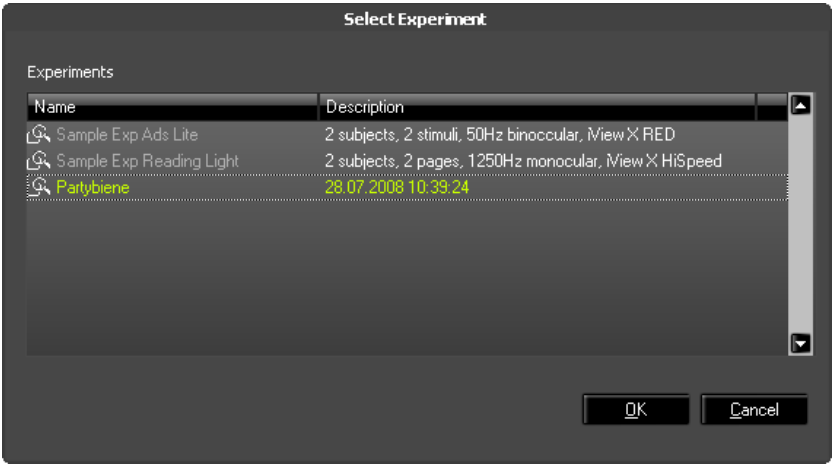


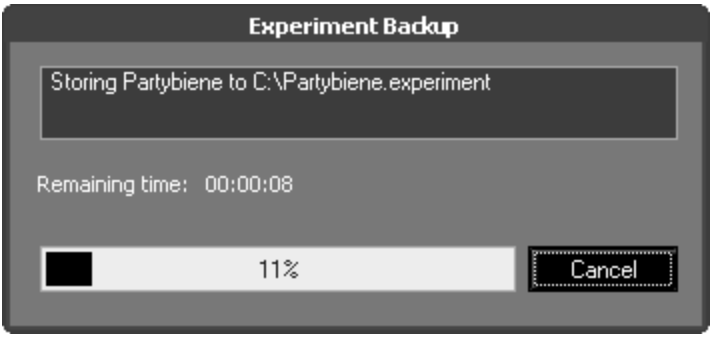
4. Enter the desired experiment file name. Browse for the folder or create a new folder where the backup will be stored.

   The **Experiment Backup** dialog will be presented, showing the following information:

   – path of the file

   – remaining time

   – progress bar



5.4.6 Experiment Restore

To restore an experiment proceed as follows:

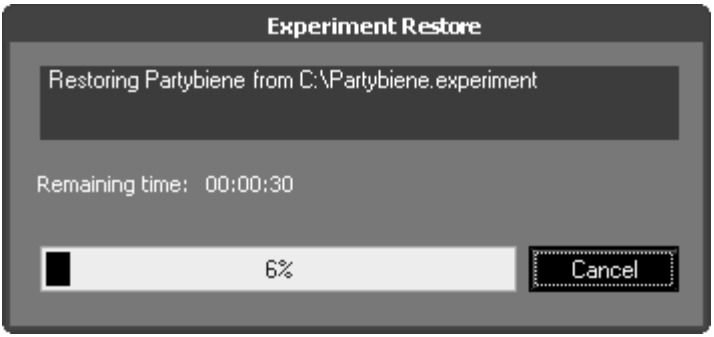
1. From the **File** menu, select the **Restore Experiment from File** command.
2. In the file selection dialog, browse for the file corresponding to the experiment you want to restore.
3. Select the experiment you want to restore.

   The **Experiment Restore** dialog will be presented, showing the following information:

   – path of the file

   – remaining time

   – progress bar



Note that the "BeGaze2\SampleExperiments" folder from the Installation CD contains sample experiments that can be restored and used in BeGaze 2.3.

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5.4.7 Delete Experiment

To delete a saved 40 experiment from the database proceed as follows:

1. From the **File** menu, select the **Delete Experiment from Database** command.

   The **Delete Experiment** dialog opens.

2. Select one or more experiments you want to delete.
3. Click **Delete Experiment**.

The experiment will be removed from the database. This process is irreversible.

Experiment Analysis

Chapter

6 Experiment Analysis

6.1 Overview of Analysis Data View

BeGaze 2.3 provides various data views to analyze gaze data. Here is a brief overview of the data views and what they are for:

Toolbar button	Data view description
	In the AOI Editor 68, you define the AOIs (**A**reas **O**f **I**nterest) that should be evaluated for the stimulus.
	The Line Graph 93 displays x and y directions of gaze data plotted as graphs over time and events displayed in a timeline.
	The Scan Path 104 displays gaze data overlay over the stimulus image/stimulus video.
	The Attention Map 114 shows gaze patterns over the stimulus image visualized as **Heat map** or **Focus map**.
	The Key Performance Indicators 121 displays relevant statistical data for each defined AOI over the stimulus image
	The AOI Sequence Chart 128 displays the AOI hit order over time.
	The Binning Chart 132 gives a statistical overview of AOI hits per binning frame.
	The Event Statistics 134 computes diverse statistics based on events and AOI hits.
	The Reading Statistics 168 computes statistics for reading experiments based on automatic generated AOIs

Note on monocular and binocular data: The Line Graph data view

shows binocular data. All other data views (except the **AOI Editor**) show monocular data.

6.2 Data View Selection

Select data view

1. Select a data view by clicking on the respective icon of the toolbar 221. Alternatively, you can choose the respective entry from the Analysis 218 menu.

   The appropriate data view will open in a new tab.

2. If required, you can repeat step 1 to open another data view.

Operating the data views

Each plug-in will open in a separate tab. Note that a plug-in can be opened several times within one experiment, e.g. to examine the scan path for several subjects/trials.

The AOI Editor can be opened only once in an experiment.

1. You can switch between the data views by clicking on the tab titles. You can also use the [CTRL] + [Tab] keyboard command to switch between the tabs.

   If multiple tabs of a data view are opened, it may be useful to rename them for differentiation.

2. Right click the tab title.
3. In the context menu, click to expand it.
4. Enter a new name in the **Change name** field.

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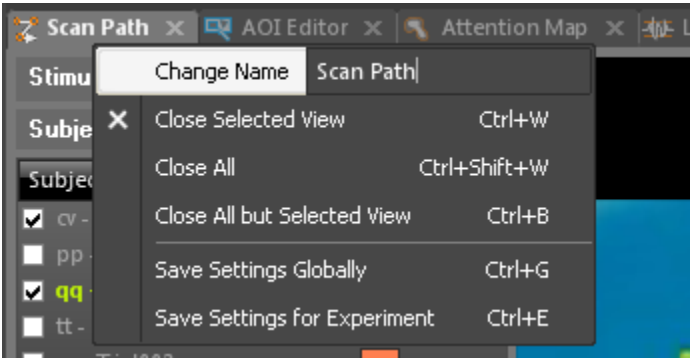

5. Press [ENTER] to confirm your entry.

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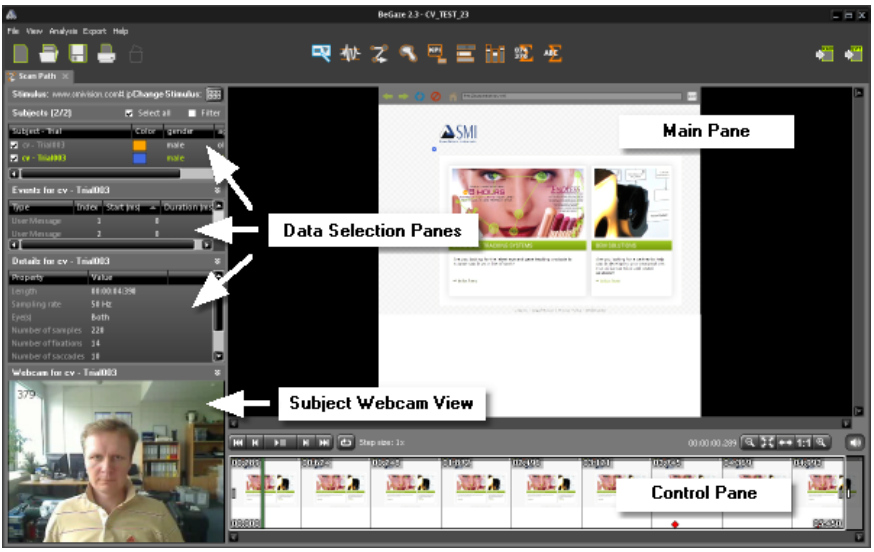
6.3 Data Views

6.3.1 Overview

Each data view consists of several data views. The views contents vary but there is a principle composition:



- **Data selection view**: On the left side of the screen, you find the views to select and restrict the data to evaluate. In the AOI Editor 68, the left view serve to create and edit AOIs.
- **Subject Usercam and Audio**: If user videos (recorded with a webcam in Experiment Center 2.3) are available, the video corresponding to the selected subject is shown here. This view can be minimized to ignore the user video and audio completely. When the view is visible, the recorded audio is played back as well.

Usercam and Audio playback requires the observation package license.

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- **Main view**: On the upper right, the main view displays the corresponding diagram, the AOI preview or the statistics.
- **Control view**: On the lower right, a control view offers individual commands for operating the display in the main view. When the webcam view is present and its panel is not minimized the subject video is played in sync with the main stimulus and the subject audio is played instead of any sound the stimulus might have.

6.3.2 Operating the data views

You can adapt the display of the views to your needs.

Resize views

1. To resize a view, position the mouse on it's border.

   The mouse cursor changes to .
2. Resize the view by dragging the mouse into the desired direction.

Hide and show views

a) To hide a view, click on it's button.

b) To display the view again, click on it's button.

Sort and modify order of columns

You can sort the lists displayed in the data selection view (see Data Views Overview 49).

1. To sort columns, click on one of the column titles. An arrow indicates if the order is ascending or descending. To change that, click on the column header again.
2. To modify the order of the columns, click on one of the headers and move the column with the mouse to a new position (Drag & Drop).

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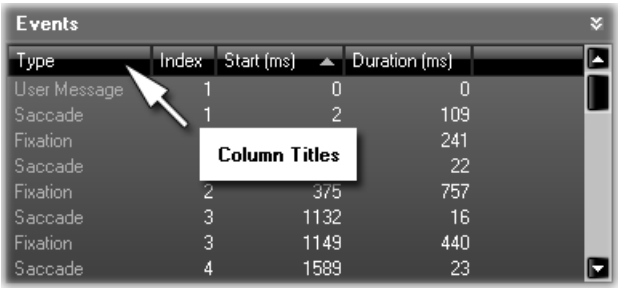

6.3.3 Stimulus Selection

The **Stimulus** selection view allows you to change the stimulus and thus the trials associated with it.

The stimulus selection is available in the following data views:

- AOI Editor 68
- Scan Path 104
- Attention Map 114
- Key Performance Indicators 121
- AOI Sequence Chart 128
- Binning Chart 132

Select stimulus

To select a stimulus proceed as follows:

1. Click on the select stimulus button to open a view with all available stimuli.

   The file name of the currently selected stimulus is highlighted.

2. Double click on the appropriate stimulus thumbnail or click on the

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select stimulus button again.

The selected stimulus will immediately be displayed in the data view's main view.

You can also use the [CTRL] + [X] keyboard command to open and close the stimulus selection and you can use the left and right arrow keys to move within the stimulus selection.

6.3.4 Subjects

6.3.4.1 Subjects Selection

In the **Subjects** view all subjects together with their associated trials are listed. The list entries are related to the selected stimulus (see Stimulus Selection 51).

The subjects selection is available in the following data views:

- Line Graph 93
- Scan Path 104
- Attention Map 114
- Key Performance Indicators 121
- AOI Sequence Chart 128
- Binning Chart 132
- Event Statistics 134
- Reading Statistics 134

Select subjects

You can decide whether you want to use all subjects trials gaze data for your analysis or if you want to restrict the analysis to a subset of them by using filters. Filters are based on the subject group properties which have been set with the SMI Experiment Center. They are stored in the experiments IDF files. If no subject properties are given, you can

configure them afterwards in BeGaze 2.3 by modifying the experiment (see Modify Experiment 39) or by double-clicking on the property you would like to change.

You can select one ore more subjects/trials with the following procedures:

a) Click the **Select all** check box to check/uncheck all items presented in the list at once.

b) To select single items, click the appropriate check box next to an item.

c) Click the **Filter** check box to enable the filter setting. The subjects list displays the group properties, e.g. age. Click on ⊞ to open the list of given filters for this property. Select the desired filter(s). The related items will automatically be checked.

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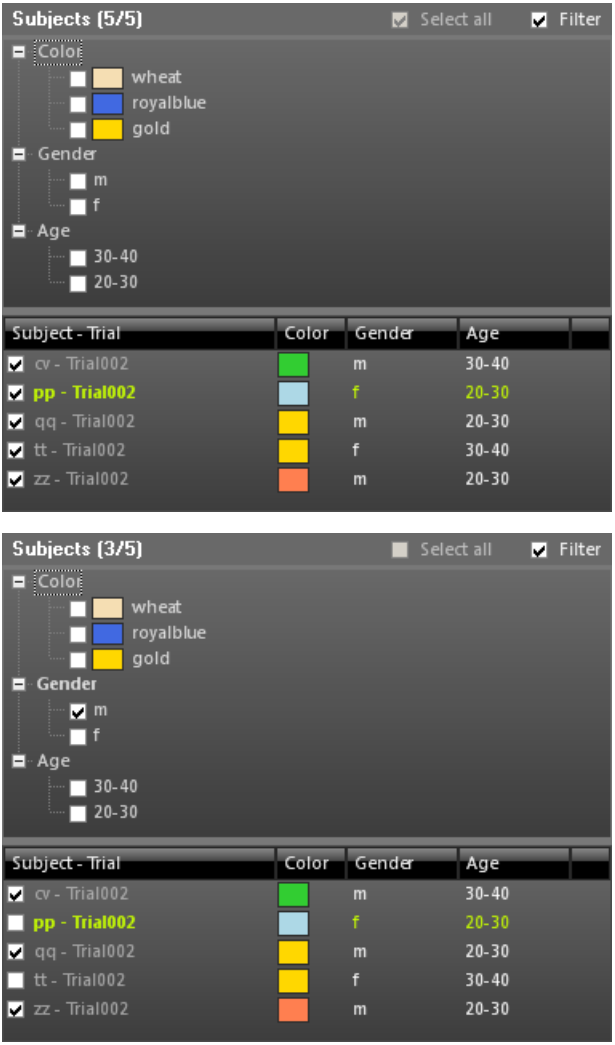


The checked items will represent the subjects trials used in the current analysis.

If you select an item (the selected item is highlighted), it becomes the selected trial and will be used to fill:

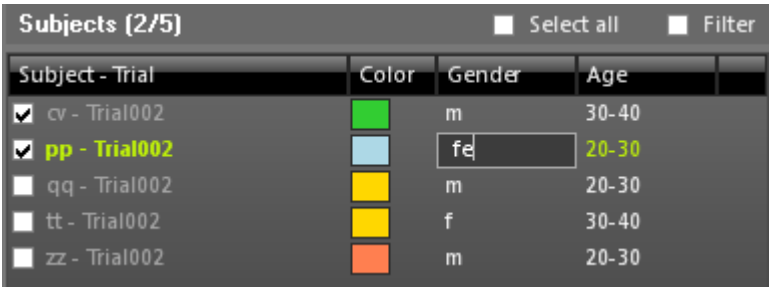
- and the Trial Details 55
- the Events List 57

Sorting is possible by clicking on the column titles.

Modify properties

While you are operating the scan path 104, attention map 114, key performance indicators 121, aoi sequence chart 128 or binning chart 132 data view, you can change the properties of a subject if required. To do so:

1. Click on the corresponding property in the **Subjects** view.
2. Overwrite the property value.



If you have the filter settings dialog open, you can neither select single subjects nor edit properties.

You can edit the **Color** property for several subjects at once by selecting them and clicking any color property of the selected items.

6.3.4.2 Subject-Trial Details

The **Details** view shows detailed information of the currently selected subjects trial.

The trial details view is available in the following data views:

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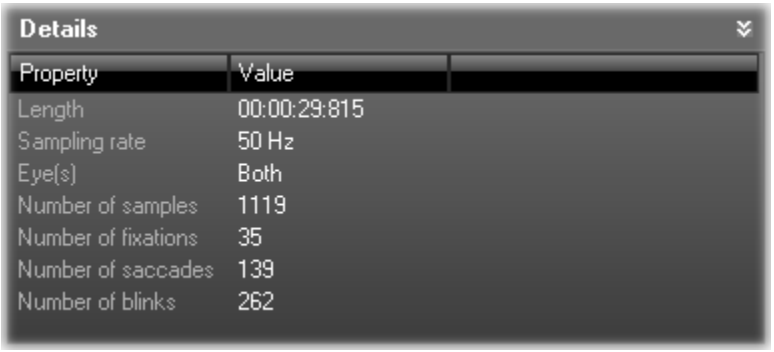
- Line Graph 93
- Scan Path 104
- Attention Map 114
- Key Performance Indicators 121
- AOI Sequence Chart 128
- Binning Chart 132



If a subject trial is selected (see Subjects Selection 52), information will be given about

- duration of the trial,
- sampling rate in [Hz],
- available data channels (left/right/both),
- number of samples,
- number of fixations,
- number of saccades,
- number of blinks.

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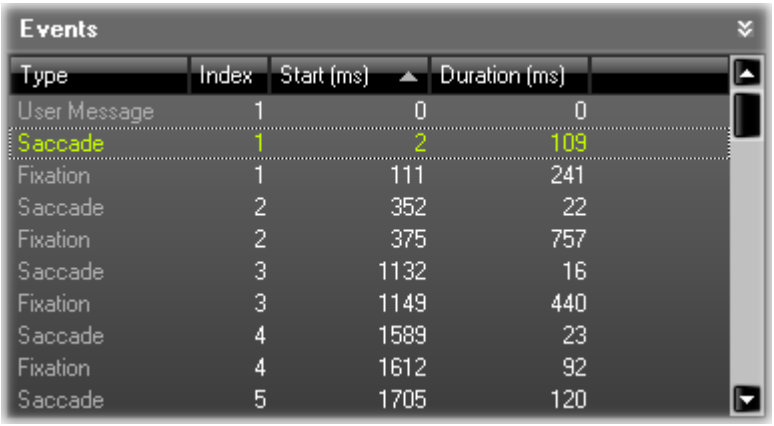
6.3.5 Events

6.3.5.1 Events Selection

The **Events** view contains the summary of events of the currently selected subjects trial (see Subjects Selection 52).

The events view is available in the following data views:

- Line Graph 93
- Scan Path 104
- Attention Map 114
- Key Performance Indicators 121



The events are listed in chronological order. For detailed information on the various events see Event Details 58.

Select event

1. Mark an item by clicking on it with the left mouse button.

   Now more information about the event will be given in the Event Details 58 field.

2. Depending on the selected data view, the main view is being updated

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as well. For example, when you click on a fixation in the scan path, the corresponding fixation is shown and selected also in the main view.

6.3.5.2 Event Details

In the **Details** view more detailed information of the currently selected event is displayed (see Events Selection 57).

The events details view is available in the following data views:

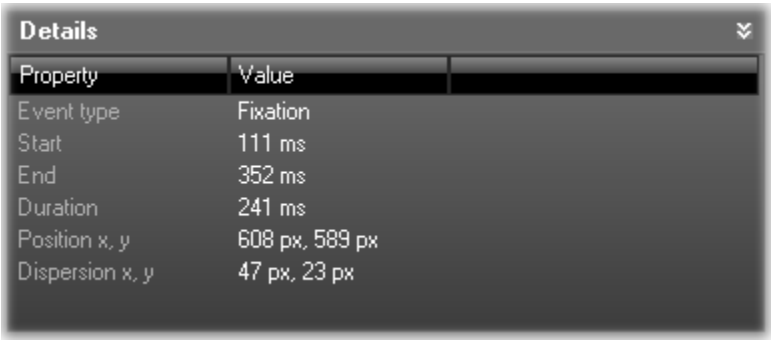
- Line Graph 93
- Scan Path 104
- Attention Map 114
- Key Performance Indicators 121

Depending on the event type, different parameters will be shown.

Fixation

If you selected a fixation, information will be given about

- start and end time,
- duration of the fixation in [ms],
- the averaged position of the fixation in [pixels],
- the dispersion of the fixation in [pixels].

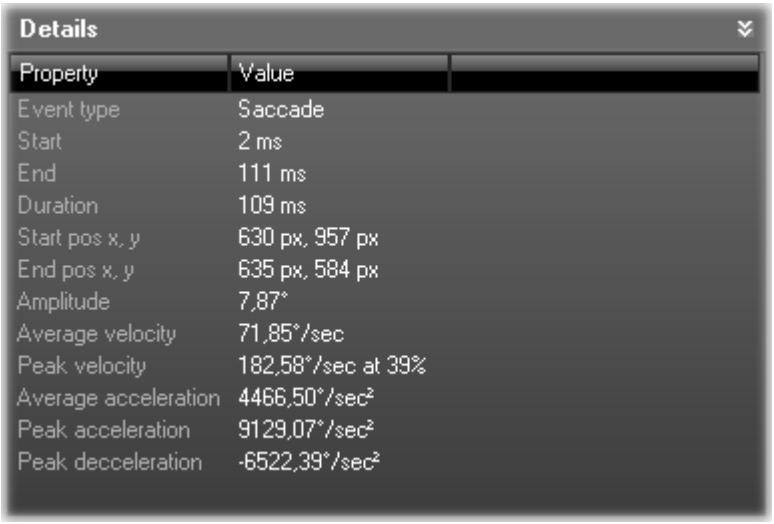


If the experiment 229 contains head tracking data in a multiple plane scenario 37, additionally image name and plane number are displayed.

Saccade

If you selected a saccade, you will get information about

- start and end time,
- duration of the saccade in [ms],
- the amplitude of the saccade in [°],
- the average and peak velocity of the saccade in [°/sec],
- the average, peak acceleration and deceleration of the saccade in [°/sec^2].



Blinks

If you selected a blink, you will get information about

- start and end time,

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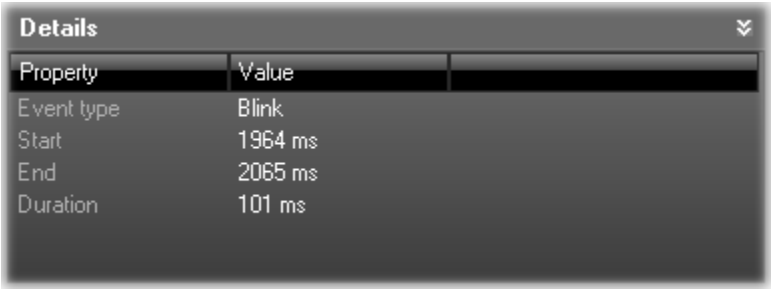
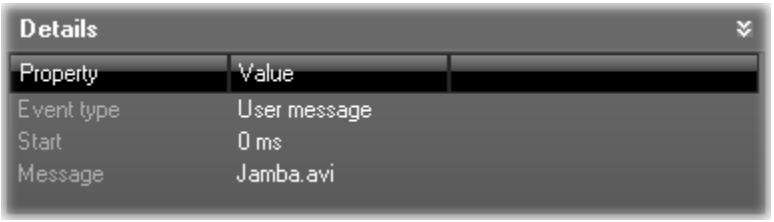
- duration of the blink in [ms].



User Messages (Generic)

If you selected a user message, you will get information about

- start time in [ms],
- actual message.



User Messages (Mouse Click, Key Presses)

In a web or screen recording experiment, the user can navigate within the presented web page. These user actions (mouse clicks, key presses) are also of the type user message. If you selected a user message of this type, the mouse click and key press information is shown.

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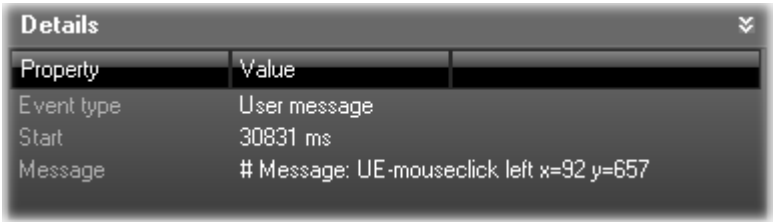
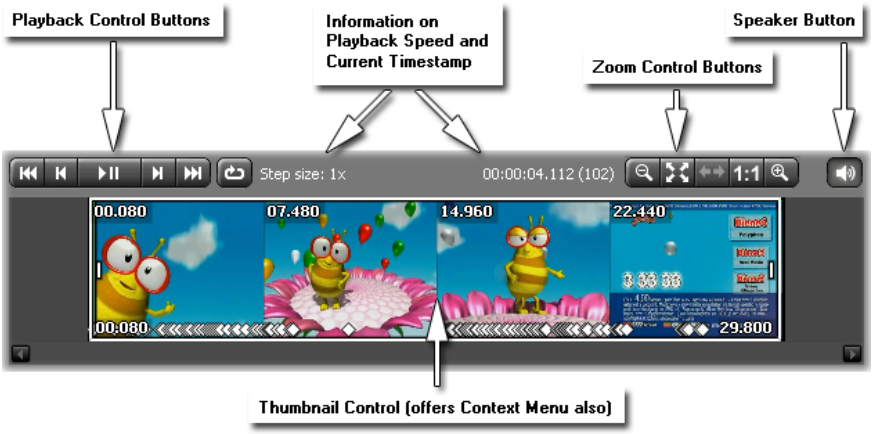


6.3.6 Player

6.3.6.1 Player Control

The player control contains commands to navigate in a video stimulus displayed in the AOI Editor 68 and respectively in a Scan Path 104, Attention Map 114 or Key Performance Indicators 121 video.



In the following sections you find a detailed description for the parts of player control interface:

- Playback Control 62
- Zoom Control 63
- Thumbnail Control 64

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- Thumbnail Control Context Menu 66

6.3.6.2 Playback Control

The playback control allows you to control the presentation of gaze measurement data and videos, both in playback or in single step mode.

In the **AOI Editor**, you can use the toolbar buttons to control the display of a video stimulus in the AOI main view. With the **Scan Path, Attention Map** or **Key Performance Indicators** data view, you use the toolbar buttons to control the display of the gaze measurement data.

Playback control buttons and key commands

To control the playback, you can use the following playback control buttons and key commands:

Button	Key command	Description
	[CTRL] + [HOME]	Jumps to the begin of the trial resp. the selected time window (see Thumbnail Control 64)
	Right arrow key	Moves presentation one step forward according to the selected step size (see Thumbnail Control Context Menu 66)
	[SPACE]	Plays/pauses the presentation
	Left arrow key	Moves presentation one step backward according to the selected step size (see Thumbnail Control Context Menu 66)
	[CTRL] + [END]	Jumps to the end of the trial resp. the selected time window (see Thumbnail Control 64)

Button	Key command	Description
		Repeats the presentation with the chosen playback speed under consideration of the selected start and end time (see Thumbnail Control Context Menu 66)
		For video stimuli only: activates and deactivates the speaker of the PC on which BeGaze 2.3 is running and plays the audio stream of the video Note that the speaker function only works if the video is played back with 100% playback speed (see Thumbnail Control Context Menu 66).
	Arrow up key	increases the step size (see Thumbnail Control Context Menu 66)
	Arrow down key	decreases the step size (see Thumbnail Control Context Menu 66)
	[B]	Sets and resets a bookmark (video stimuli)
	[CTRL] + arrow right	Jumps to the next bookmark
	[CTRL] + arrow left	Jumps to the previous bookmar

6.3.6.3 Zoom Control

For large images and videos, you can use the zoom control to adapt the display of the selected stimulus to the size of the data view's main view (e.g. the AOI main view of the **AOI Editor**).

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Here is an overview of the buttons and what they are for:

Zooms out

Fits the stimulus display to the size of the main view

Fits the stimulus display to the width of the main view (useful for webpage stimuli)

Displays stimulus in full-scale (= original stimulus size)

Zooms in

Whether the zoom control is active or not, depends on the proportion between the BeGaze 2.3 program window size and the size of the presented stimulus.

You can also navigate in the displayed stimulus using the following procedures if you are using a mouse with a mouse wheel:

a) Turn the mouse wheel to scroll up and down.

b) Press the [SHIFT] key, keep it pressed and turn the mouse wheel to zoom in and out.

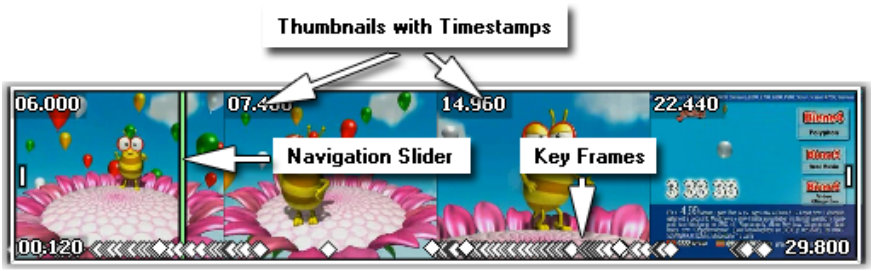
6.3.6.4 Thumbnail Control

The thumbnail control displays the stimulus presentation over time as a sequence of thumbnails which represent the stimulus' single images at specific timestamps. Using the thumbnail control, you can navigate in the stimulus presentation resp. in the presentation of the Scan Path 104, the Attention Map 114 or the Key Performance Indicators 121.

The thumbnail control gives an overview on

- the time window of the trial (for still images),

- user defined bookmarks in all stimuli types (video, still image, web),
- in case of a video stimulus the video position, the time window of the trial and the set key frames 85,
- and additionally in case of a web stimulus and screen recording the user messages 58 (mouse click, key presses).



You can adapt the settings of the thumbnail control to your needs. For example, you can restrict the number of displayed thumbnails by increasing the interval of seconds when a thumbnail should be inserted to the control (see Thumbnail Control Context Menu 66).

Control playback using the mouse

When you hover the mouse over the thumbnail control, the stimulus/video will be played back in the main view of the data view in real-time. The navigation slider moves according to the mouse movement and indicates the current position within the stimulus resp. the video. You can lock the navigation slider and thus freeze the video with a single click on the appropriate thumbnail.

Add and delete bookmarks

Press B on the keyboard in order to add a bookmark on the current position where the green navigation slider is positioned. A yellow circle is added to show the bookmark positions. You can use the key combination Ctrl + Left/Right to navigate between bookmarks. Press B a second time while you are on a bookmark to deletes the bookmark.

Bookmarks are global for all data views within the experiment for the

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selected stimuli.

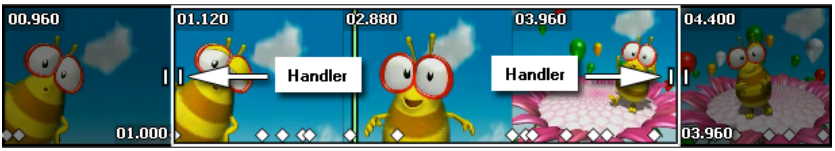
Modify Time Window

It is possible to limit the analysis time and view a smaller time window.

1. Position the mouse cursor at the left border of the first thumbnail.
2. Press the left mouse key and drag the mouse cursor on the timestamp in the thumbnail control which should define the start time.
3. Position the mouse cursor at the right border of the last thumbnail.
4. Press the left mouse key and drag the mouse cursor on the timestamp which should define the end time.

Alternatively, you can use the handler to limit the time window:

1. Click on the left handler to activate it.
2. Use the left and right arrow keys to limit the time window.



The selected time window is highlighted. The movement of the navigation slider will now be restricted to this time window. Start and end time of the time window are displayed at the bottom of the thumbnails.

6.3.6.5 Thumbnail Control Context Menu

The context menu of the thumbnail control contains commands to manage the display and the replay of the stimulus.

1. Right click the thumbnail control.

   The context menu opens, offering the following commands.

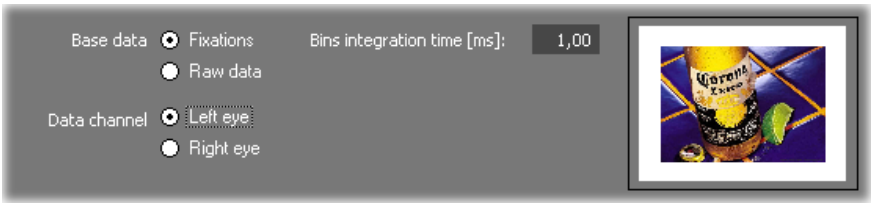
2. **Playback Speed**: Select one of the entries in the pop-up menu to modify the playback speed (**25%**, **50%**, **100%**, **200%**, **400%**).

3. **Thumbnail Time Window**: You can adjust the number of thumbnails which are displayed in the thumbnail control. Select one of the entries in the pop-up menu (**1 second**, **2 seconds**, **5 seconds**, **10 seconds**, **Fit to Width, Fit to selection**). For example, the **5 seconds** entry will set a thumbnail every 5 seconds, the **Fit to Width** entry will distribute the stimulus' thumbnails according to the available space on the screen whereas the **Fit to Selection** will distribute the thumbnails like **Fit to Width** but only for the selected video area.
4. **Step Size**: Video streams are stored as a sequence of single images. The step size determines how many image frames are skipped when you navigate the stimulus presentation with the Playback Control 62. Select one of the entries (**Single Step (Videoframe)**, **Videoframe x 2**, **Videoframe x 4**, **Videoframe x 8**, **Videoframe x 16**, **Videoframe x 32** , **Videoframe x 64**, **Videoframe x 128**, **Videoframe x 256**).

You can also use the Arrow up and the Arrow down keys to increase/decrease the step size.

6.3.7 Chart Display Modes

In the Chart Display Modes view, you can adapt the settings for the AOI Sequence Chart 128 and the Binning Chart 132. If you change a setting, the respective display will update immediately.



The view also displays a thumbnail of the currently selected stimulus to the right. Operate this view with the following steps:

1. **Base data**: Select whether AOI hits percentages are computed using data from calculated **Fixations** or measured **Raw data**.

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2. **Data channel**: Select the data channel to be considered for AOI hits. In case of monocular recordings, the channel is selected automatically.
3. **Bins integration time [ms]**: Change the duration for the time slices displayed. You can adjusted the time for single time slices in milliseconds ranging from the sampling interval value up to the trial duration. Note, that this setting is available with the **Binning Chart** data view only.

You can change, delete or create AOIs with the AOI Editor 68.

6.4 AOI Editor

6.4.1 Overview

The following data views in BeGaze 2.3 require the existence of AOIs (**A**reas **O**f **I**nterest):

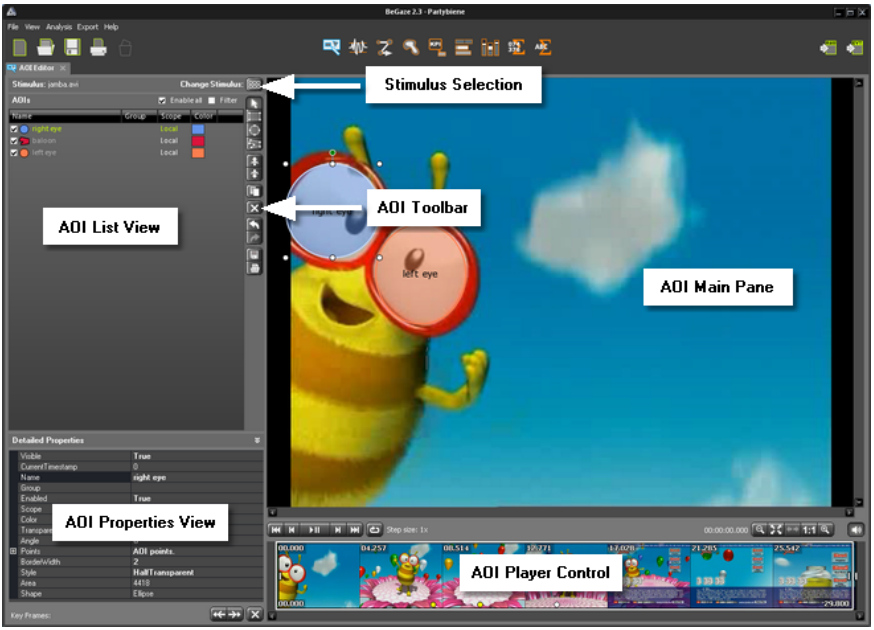
- AOI Sequence Chart 128
- Binning Chart 132
- Event Statistics 134
- Reading Statistics 134
- Key Performance Indicators 121

AOIs can be defined for still images stimuli as well as for video stimuli where the AOIs change their position and size during the sequence of single video frames (Move&Morph™ functionality).

If you have already created AOIs for the current stimulus image, they are stored in the database and will be displayed as overlay over the image. Note, that also AOIs that were created with the iView eye tracker will be displayed if they were collected in the Create Experiment wizard 26 with the stimulus images 32. If no AOIs are displayed, you have to create them prior to selecting one of the above views.

You can create new AOIs and edit or delete existing ones in the **AOI**

Editor. In the following you find a short description of it's interface:



- The **AOI main view** shows all defined AOIs.
- The **AOI list view** lists all AOIs for the selected stimulus image by name. You can create new AOIs and edit existing ones via the **AOI Editor** toolbar 70 on the right of this view. If several stimuli are used within the experiment, you can select another one via the **stimulus selection** area on the top of the AOI list view.
- In the **AOI detailed properties** view, you can view the properties of an AOI selected in the AOI list view and edit it.
- The **AOI player control** view shows the stimulus presentation over time. In case of a video stimulus, this view will show the video's contents image by image.

If the reading package is licensed, reading AOIs for paragraphs,

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sentences, words and character are automatically generated in Experiment Center and been used in BeGaze. These reading AOIs cannot be self created. For more information, please see Reading AOI Statistics 182

6.4.2 Toolbar

The **AOI Editor** toolbar is located on the right of the AOI list view. It gives you short-cuts to create and edit AOIs. Here is an overview of the buttons and what they are for:

Selects an AOI and switches to edit mode

Draws a rectangular AOI

Draws an ellipsoidal AOI

Draws a polygonal AOI

Changes the priority of overlaying AOIs. The selected AOI gets a higher priority.

Changes the priority of overlaying AOIs. The selected AOI gets a lower priority.

Deletes a selected AOI

Duplicates the selected AOI

Undoes the last step

Redoes the last step

Saves AOIs to an XML file

Loads AOIs from an XML file

6.4.3 Open AOI Editor and Select Stimulus

1. Click in the toolbar 221.

   The **AOI Editor** opens, displaying the experiment's stimulus. If several stimuli are used in the experiment, you can now select another one (see Stimulus Selection 51).

2. Proceed with one of the following steps:

   – Create AOIs 71

   – Edit AOIs 73

   – Delete AOIs 86

6.4.4 Create AOIs

Prerequisite

A stimulus is displayed in the AOI's main view (see also Stimulus Selection 51).

Create a new AOI

1. Select the shape of the AOI you want to create by clicking on the appropriate button.

   – If you want to create an ellipsoidal AOI, click on the button. Then left-click in the image to set the start point, keep the mouse button pressed and drag the mouse vertically over the image to define the size of the ellipse. Release the mouse button if the desired size is reached.

   – If you want to create a rectangular AOI, click on the button.

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Left-click in the image to set the start point, keep the mouse button pressed and drag the mouse vertically over the image to define the size of the rectangle. Release the mouse button if the desired size is reached.

– You can also create a polygonal AOI by clicking on the button. Click in the image to set the starting point of the first straight line. With the second click you set the end point of the first line which is also the starting point of the second line etc. By clicking, moving the mouse, and clicking again you will define the shape of the polygon. When you have completed the AOI except for the last side of the polygon, double click the left mouse button to mark the last corner point. The last corner point of the polygon will automatically be connected with the starting point.

In case of a video stimulus, BeGaze 2.3 will automatically set a key frame for each new AOI position, a changed AOI shape/size, and a change of the AOI visibility (see also Navigate through Key Frames 85).

2. Name the AOI. A new AOI is named ”AOI” followed by a serial number (e.g. AOI 001). To assign a meaningful name edit it in the box that appears immediately after you draw the AOI. You can double click the AOI afterwards to get the name editing box back.

   Alternatively, you can double click the AOI in the AOI list view or click on the desired AOI in the AOI main view and overwrite the given name in the **Name** field of the AOI detailed properties view.

3. You may set another new AOI at a later time position (e.g. with a video stimulus). To do this, position the time cursor in the AOI player control on the appropriate image thumbnail (see Thumbnail Control 64).

4. To create the new AOI, repeat steps 1 and 2.

If required, you can change the position, rotation angle or the shape of an AOI. Fore more information, see the topic entitled Edit AOIs 73.

6.4.5 Edit AOIs

You can edit existing AOIs as follows:

- rename AOI 74,
- change position and/or shape of a still image stimulus AOI 76,
- change position and/or shape of a video stimulus AOI 78,
- change the AOI priority 78,
- change the visibility of a selected AOI, see Change AOI's Visibility 83,
- edit several properties for a selected AOI, see Edit AOI Properties 79.

Prerequisite

If you want to edit an AOI, you have to switch to the edit mode by clicking on the button.

Enable/Disable AOI

- AOI's are enabled by default and can be disabled if the AOIs shall not be considered in the whole experiment (statistics, ...)
- "Enable all" allows to enable and disable all AOIs in one go or with the filter when clicking on the filter checkbox
- Individual AOIs can be enabled/disabled by clicking on the checkbox left to the AOI name.

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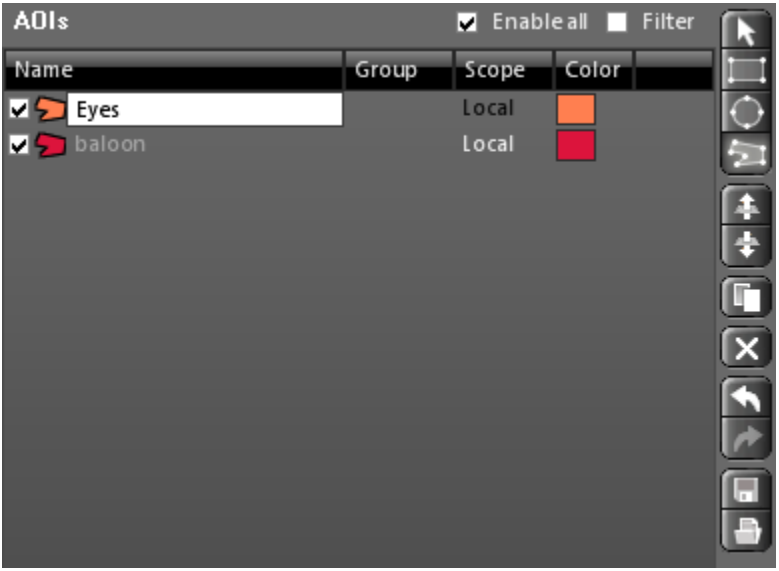
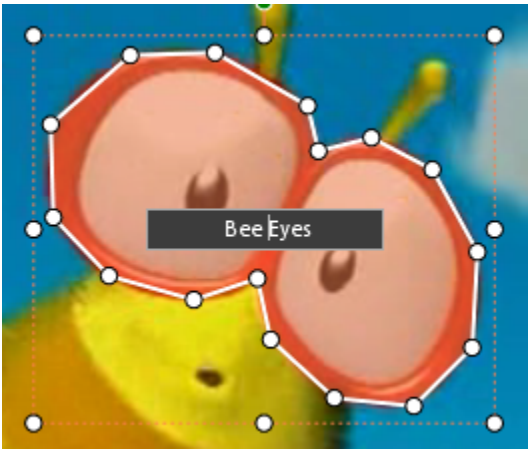


Rename AOI

1. Double click the desired AOI in the main view and change the name.



Or you can click the AOI in the AOI list view and overwrite the given

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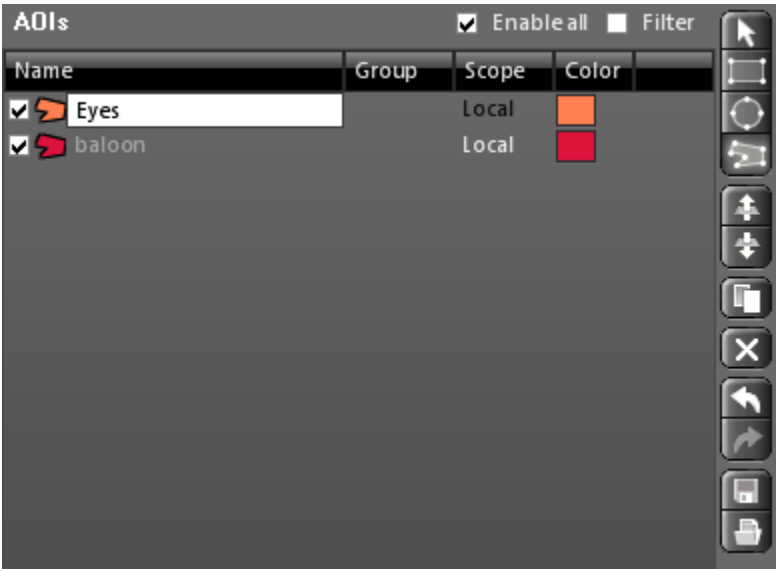
name.



Alternatively, you can click on the desired AOI in the AOI main view and overwrite the given name in the **Name** field of the AOI detailed properties view (after expanding it).

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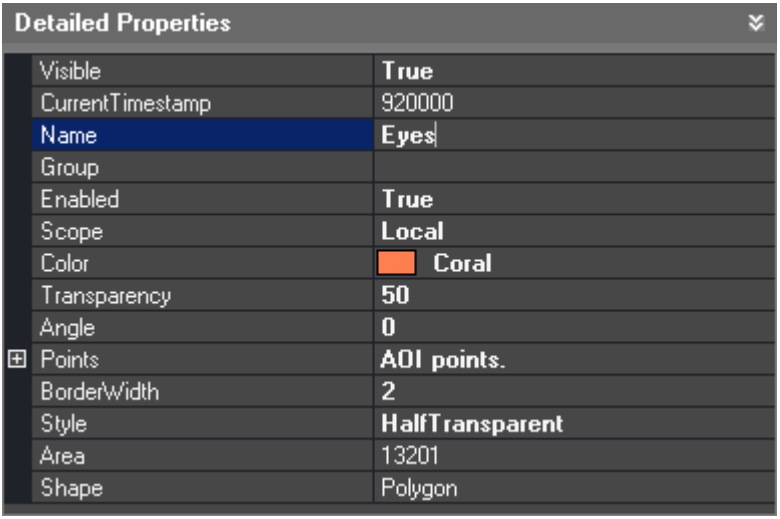

Change position and/or shape of a still image AOI

If you want to change the position or the shape of an AOI, proceed as follows:

1. Click on the desired AOI in the AOI main view.

   The selected AOI is marked by selection handles (small squares at the corner points of the AOI).

   Polygons and group of AOIs are marked in addition with a frame and additional handlers.

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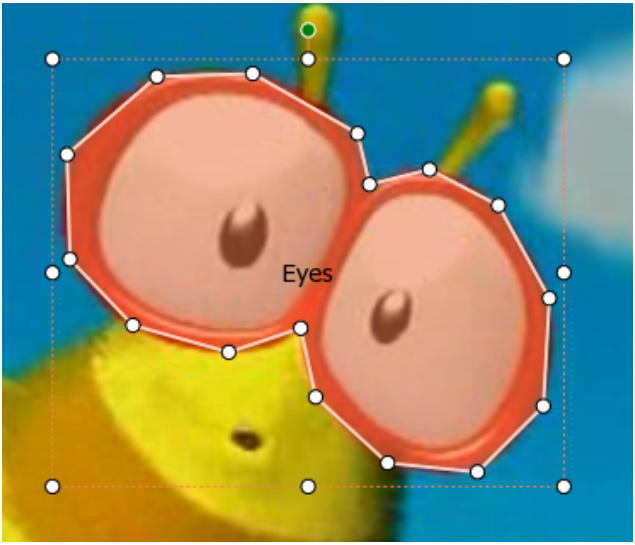

2. You can now move the AOI by clicking somewhere in the AOI area and dragging the AOI to the desired position while keeping the left mouse button pressed. To change the shape (e.g. the size) of the AOI, click on the selection handles and drag them in the appropriate directions. The AOI will behave the same as in other graphic programs.
3. AOIs can be rotated by using the round handler on top
4. You can change the size of the selected AOI by pressing the [S h i f t] key and turning the mouse wheel or by using the handlers in the corners.
5. There are two options only available when right-clicking on a polygonal AOI: **Add Point** and **Remove Point**. You can add new points to an existing polygon by hovering over an edge, right-clicking and selecting the **Add Point** option (notice the mouse cursor changing while hovering over an edge). An existing point can be removed by hovering over the point and selecting **Remove Point** from the context menu.

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Change position and/or shape of a video stimulus AOI

With a video stimulus, the position and shape of one AOI can change in the course of the video. With the following steps, you adapt the AOI to the changed display detail.

1. Click on the desired AOI in the AOI main view.

   The selected AOI is marked by selection handles (small squares at the corner points of the AOI).

2. In the AOI player control view, position the time cursor on the appropriate video frame (see Thumbnail Control 64).

   The selected video frame is displayed in the AOI main view. The AOI is located on it's former position.

3. Move it to it's new position. If necessary, change it's shape/size/ rotation also (as described in the section Change position and/or shape of a still image AOI 76).

   BeGaze 2.3 will automatically set a key frame for the new AOI position (see also Navigate through Key Frames 85).

Tip: It will be efficient to use key commands to navigate in the player control (see Playback Control 62) and to use the mouse for changes on the AOI shape and position.

Removing points from a polygon in a certain key frame affects the shape in all key frames so a warning pops up when using these options on a polygon in a video stimulus.

Change AOI Priority

If you have several AOIs in a stimulus image that overlay upon each other, and the chosen diagram only allows evaluation of one AOI per time (which is the case with the Binning Chart 132), only the one with the highest priority will be validated. The priority of an AOI corresponds to its position in the list view: AOIs that are placed on top of the list have a higher priority than AOIs with a lower position. You can change the priority

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of an AOI by proceeding the following two steps:

1. Mark the AOI to be changed in the list view.
2. Click on the and buttons to move the AOI to the desired position in the list and, thus, assign it the desired priority.

6.4.6 Edit AOI Properties

You can change the properties of a selected AOI as follows:

1. Click on the button to switch to the edit mode.
2. Click the desired AOI in the AOI list view. Alternatively, you can click on the desired AOI in the AOI main view. Expand the AOI detailed properties view.

   Now you can enter the desired values directly in the AOI detailed properties view.
3. **Visible**: This field is displayed with a video stimulus only. Click on to open the drop-down menu. Select **True** if the AOI is visible at the current timestamp and select **False** if the AOI gets invisible at this time (this means that AOI of the displayed theme fades out).
4. **Name**: If required, overwrite the given name.
5. **Group**: You can assign a group name to several AOIs and use it to sort of filter the AOI list (useful for reading or web experiments).
6. **Enabled**: This sets whether the AOI is taken into account in the other plugins (KPI, Event Statistics and so on). A disabled AOI is drawn in a dash-dot pattern instead of a full line one. This setting is identical to toggling the checkbox in front of the AOI in the AOI list. The default setting is **True**.
7. **Scope**: Can take the values of **Local** or **Global**. **Local** shows that the AOI is available for the current stimulus only and is the default setting while **Global** means it is available in the whole experiment, maintaining its name and color in all stimuli. When first creating an AOI it is set to **Local** and exists in the current stimulus only and changing it to **Global** replicates it in all the other stimuli in the

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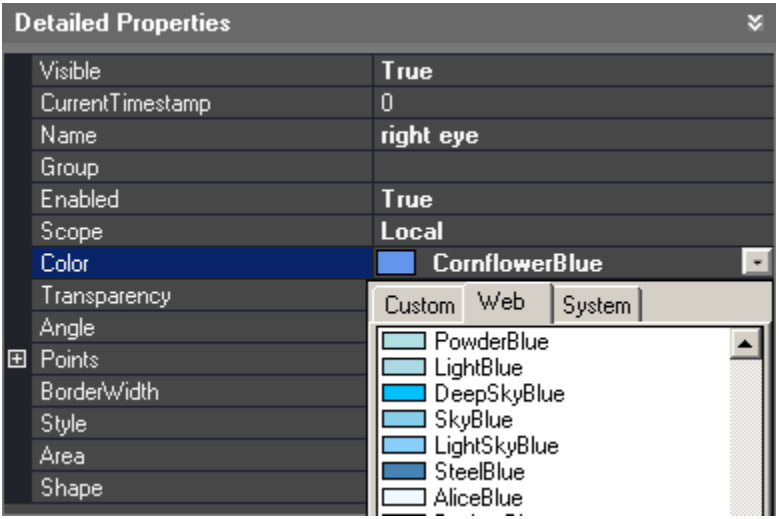
experiment. The position and shape can be changed independently in each stimulus afterwards.

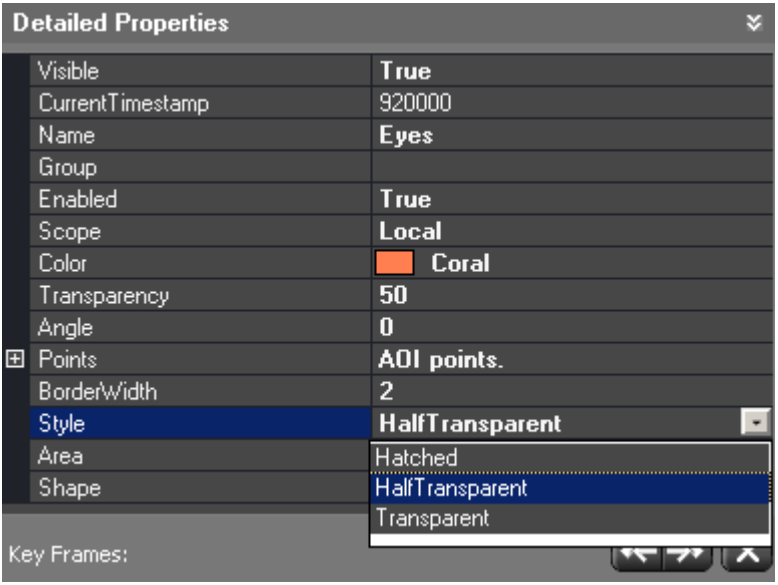
8. **Color**: New AOIs are created with standard colors. It is recommended to change these colors if the AOIs are hardly recognizable on your stimulus image. Click on to open the color selection drop-down field, offering separate color tabs. Select the desired color.



9. **Points**: Click on to display the list of points that define the AOI's position and size. This list is dependent of the type and should contain exactly 2 points for rectangle or ellipse, and at least 3 points for polygon. You can modify the AOI's position and size by entering new values.

10. **Border Width**: Enter a value between 1 and 10 to define the AOI's border width. The default value is 2.

11. **Style**: Click on to open the transparency selection drop-down menu. Select the transparency style.



12. **Area** is showing the size of the AOI in square-pixel.

The other fields in the AOI detailed properties view, such as Current Timestamp and Shape give further information on the AOI. These properties cannot be edited.

For convenience there are two alternative methods for editing the most commonly used properties rendering the Detailed Properties panel useful for advanced editing only:

1. Edit the Name, Group, Scope, Color and Enabled state (checkbox) directly in the AOI list view.

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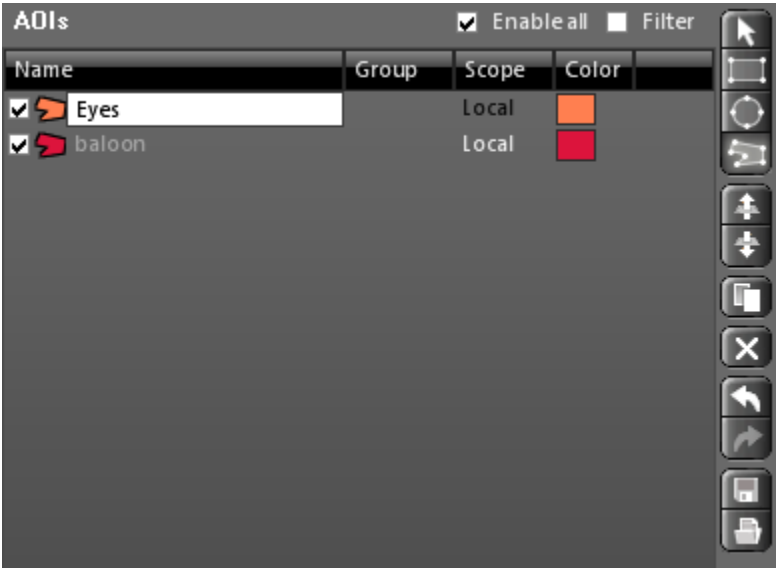

2. Edit the above and more in the context menu that shows when you right-click on an AOI in the main view. The options that are not available for the specific AOI are grayed out.

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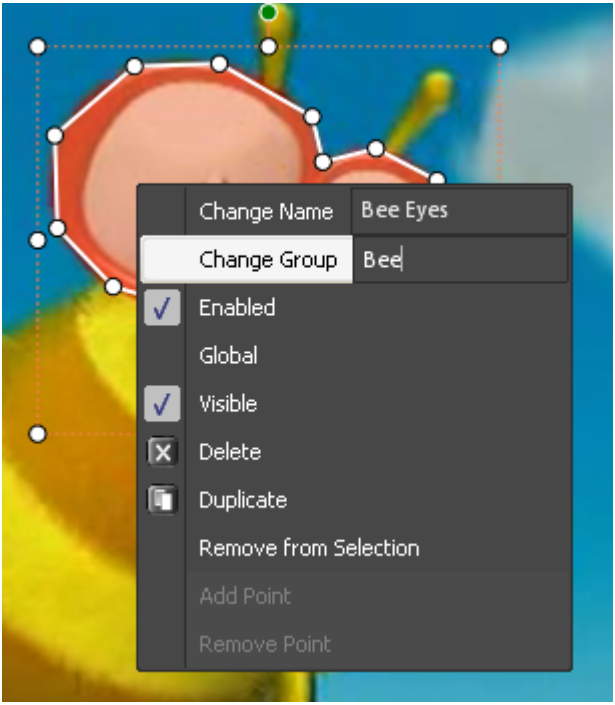

6.4.7 Change AOI's Visibility

The visibility of AOIs affects video stimuli only. A video stimulus shows the objects / protagonists / visuals you are interested in, but they may appear or disappear in the course of the video. To reflect this, an AOI can have the visible and invisible status.

1. Click on the button to switch to the edit mode.
2. Click the desired AOI in the AOI main view.
3. Pressing the [v] key, you can toggle the visibility of the selected AOI.

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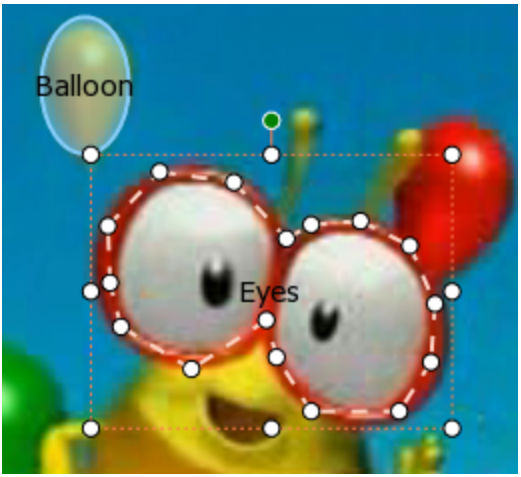
Alternatively, you can set the visibility of a selected AOI in the AOI property view (see Edit AOI Properties 79).

Invisible AOIs are indicated with a dotted border.



Note, that no AOI hit is counted while the AOI has the invisible status. This is true even if BeGaze 2.3 detects the gaze position meets the AOI area. This means that no AOI hits are emitted in the AOI Sequence Chart 128 and the Binning Chart 132.

Example: In the course of the video, a new character appears on the screen. At this timestamp you draw the corresponding AOI in the video's fixed-image (the first key frame for this AOI is set). After some seconds, the character disappears. At this timestamp you set the AOI to invisible (the second key frame for this AOI is set). Some seconds later, the character appears again. You set the AOI to visible again (the third key frame for this AOI is set).

BeGaze 2.3 evaluates the AOI in the following manner: The video starts with the AOI invisible until the AOI key frame 1 is reached. Between key frame 1 and key frame 2 and from key frame 3 to the end of the video (the AOI is visible), the hits for this AOI are count. Between the key frames 2 and 3 when the AOI is set to invisible, no hits for this AOI are count even if a subject gazed at the AOI.

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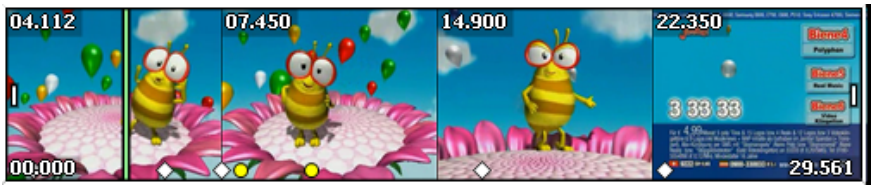
6.4.8 Navigate through Key Frames

Move&Morph

With a video stimulus BeGaze 2.3 sets a key frame for each AOI, and also for each changed AOI position, a changed AOI shape/size, and a change of the AOI visibility. Between the successive key frames of an AOI, BeGaze 2.3 automatically calculates the tweening of the AOI's motion and size and adapts it to the single images of the video sequence lying between these key frames. (Move&Morph)

With the help of key frames, you can navigate through a sequence of AOIs, e.g. to change their position, size or shape if necessary. The Thumbnail Control 64 indicates the key frames which are set for a video stimulus with ◇.



Navigate through key frames

The key frames control is located on the bottom of the **AOI Editor**.

1. Position the time cursor in the AOI player control at the beginning of the video or on the appropriate video's single image (see Thumbnail Control 64).
2. If you want to restrict the navigation to one special AOI, now select the appropriate AOI in the AOI list view. If you want to navigate through the complete series of the stimulus' key frames, make sure that no AOI is selected.
3. Navigate through the frames:

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– Click to jump to the next key frame relative to the image currently displayed.

– Click to move back to the previous key frame.

– Click to delete the current key frame or press [D]

Navigate through key frames using hotkeys

You can use the following hotkeys for fast navigation through the key frames:

Keys	Description
[HOME]	jumps to first key frame
[END]	jumps to last key frame
[PG Up]	goes to next key frame
[PG Dn]	goes to previous key frame
[D]	deletes the current selected key frame

6.4.9 Delete AOIs

You can delete AOIs as follows:

1. Click on the button to switch to the edit mode.
2. Mark one or more AOIs that should be deleted either in the stimulus image or in the AOI list view. A selection in the stimulus image will automatically select the appropriate item in the AOI list view and vice versa.
3. Click on the button.

Alternatively, you can press the [DEL] key or right-click on the AOI and select the **Delete** option in the context menu.

When deleting AOIs that have the **Scope** setting set to **Global** a warning dialog with several options appears informing you that you are about to delete the global AOIs from all the stimuli in the current experiment.

6.4.10 Save and Load AOIs

Save AOIs

AOIs will be automatically saved in the database when you close the **AOI Editor**. You can also save AOIs in an XML file (*.xml), if, for example, you want to reuse a stimulus image with the appropriate AOIs in further experiments.

1. Click on the button and select the name and the storage folder for the XML file.

Load AOIs

1. To load AOIs for the current image click on and select an XML file (*.xml) from the file selection dialog.

To create an XML file using an external tool, follow the AOI Format Description (see AOI Format Description 87).

6.4.11 AOI Format Description

The XML file that contains the AOIs has the following structure (except for automatic generated reading AOIs):

```
<?xml version="1.0"?>
```

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```
<ArrayOfDynamicAOI
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
  <DynamicAOI 89>
    <Points 90>
      <Point>
        <X>1003</X>
        <Y>748</Y>
      </Point>
      <Point>
        <X>1169</X>
        <Y>886</Y>
      </Point>
    </Points>
    <Enabled 89>true</Enabled>
    <Group 89>Main Group</Group>
    <Scope 89>Local</Scope>
    <Angle 90>0</Angle>
    <BorderWidth 90>2</BorderWidth>
    <Type 89>Rectangle</Type>
    <Style 90>HalfTransparent</Style>
    <Transparency 90>50</Transparency>
    <Area 90>22908</Area>
    <Color 90>NamedColor:Blue</Color>
    <Name 89>Logo Name</Name>
    <Font 90>
      <FontName>Tahoma</FontName>
      <FontSize>13</FontSize>
      <FontStyle>Regular</FontStyle>
      <FontUnit>Point</FontUnit>
      <FontGdiCharSet>1</FontGdiCharSet>
      <FontGdiVerticalFont>false</FontGdiVerticalFont>
    </Font>
    <Visible 90>true</Visible>
    <CurrentTimestamp 90>0</CurrentTimestamp>
    <KeyFrames 90>
      <KeyFrame>
        <Points>
          <Point>
            <X>1</X>
            <Y>37</Y>
```

```
          </Point>
          <Point>
            <X>167</X>
            <Y>345</Y>
          </Point>
        </Points>
        <Angle>0</Angle>
        <Area>51128</Area>
        <Visible>true</Visible>
        <Timestamp>0</Timestamp>
      </KeyFrame>
 ...
    </KeyFrames>
  </DynamicAOI>
  ...
</ArrayOfDynamicAOI>
```

Description of Elements:

- **ArrayOfDynamicAOI**: the root element, contains one or more DynamicAOI 89 elements.
- **DynamicAOI**: corresponds to one static AOI and has the following child elements:
- **Name**: defines the name of the AOI
- **Type**: defines the shape of the AOI and should have one of the following values:

  – Rectangle

  – Ellipse

  – Polygon
- **Enabled**: defines the state of the AOI. Disabled AOIs are present only in AOI Editor 68. This element is optional and the implicit value is true.
- **Group**: contains the name of the group. This element is optional and the implicit value is empty.
- **Scope**: defines the scope of the AOI. This element is optional and the implicit value is Local. It should have one of the following values:

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– Local

– Global

- **Points**: contains the list of points that defines the AOI and it is dependent of the type 89. The list should contain exactly 2 points for Rectangle or Ellipse, and at least 3 points for Polygon.
- **Angle**: defines the rotation angle of each point defining the AOI around the center of gravity of the AOI. It is expressed in degrees.
- **Color**: defines the color of the pen and brush used to draw the AOI. This element is optional and the implicit value is NamedColor:Black.
- **BorderWidth**: defines the width of the pen used to draw the AOI. This element is optional and the implicit value is 2.
- **Font**: defines the font used to draw the name of the AOI. This element is optional and the implicit values for the child elements are FontName = Tahoma and FontSize = 13.
- **Style**: defines the filling style of the brush used to draw the AOI. This element is optional and the implicit value is HalfTransparent. It should have one of the following values:

  – Hatched

  – Transparent

  – HalfTransparent
- **Transparency**: defines the transparency level (0..100) and is taken into account when the Style 90 is HalfTransparent. This element is optional and the implicit value is 50.
- **Area**: the size of the AOI expressed in square pixels
- **Visible**: true if the AOI is visible at the current timestamp 90.
- **CurrentTimestamp**: defines the current timestamp.
- **KeyFrames**: defines several key frames made up of Points 90, Visible 90 and Timestamp 90. The Dynamic AOI position is interpolated in time between the defined key frames.

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Examples

The minimal structure that describes a static AOI should looks like:

```
<DynamicAOI 89>
  <Points 90>
    <Point>
      <X>1003</X>
      <Y>748</Y>
    </Point>
    <Point>
      <X>1169</X>
      <Y>886</Y>
    </Point>
  </Points>
  <Type 89>Rectangle</Type>
  <Name 89>Volvic Logo</Name>
  <Visible 90>true</Visible>
</DynamicAOI>
```

The minimal structure that describes a dynamic AOI should looks like:

```
<DynamicAOI 89>
  <Points 90>
    <Point>
      <X>1</X>
      <Y>37</Y>
    </Point>
    <Point>
      <X>167</X>
      <Y>345</Y>
    </Point>
  </Points>
  <Type 89>Rectangle</Type>
  <Name 89>Bee</Name>
  <Visible 90>true</Visible>
  <CurrentTimestamp 90>0</CurrentTimestamp>
  <KeyFrames 90>
    <KeyFrame>
      <Points>
        <Point>
          <X>1</X>
```

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```
            <Y>37</Y>
          </Point>
          <Point>
            <X>167</X>
            <Y>345</Y>
          </Point>
        </Points>
        <Visible>true</Visible>
        <Timestamp>0</Timestamp>
      </KeyFrame>
      <KeyFrame>
        <Points>
          <Point>
            <X>1</X>
            <Y>60</Y>
          </Point>
          <Point>
            <X>221</X>
            <Y>345</Y>
          </Point>
        </Points>
        <Visible>false</Visible>
        <Timestamp>80000</Timestamp>
      </KeyFrame>
    </KeyFrames>
  </DynamicAOI>
```

6.5 Line Graph

6.5.1 Overview

The **Line Graph** data view displays un-interpreted eye tracking data and gaze events for scientific or informal purposes. Data and events are plotted as lines on a timeline diagram.

Operate the **Line Graph** data view with the following steps:

1. In the Subjects Selection 52, select a single trial.

   The Line Graph Main Pane 96 and Line Graph Data Table 98 the are updated for the selected trial.

   While selecting trials, the Events Selection 57 view and the Trial Details 55 view shows information about the currently selected trial or event.

2. In the Line Graph Miniview 99, change to the desired view tab.

   The **Miniview** displays the selected stimulus correlated with the gaze

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position of the current Diagram Cursors 98.

6.5.2 Events List

The general functionality of this view is described in Events List 57. The blue data cursor and the red auxiliary cursor will frame the marked event in the Line Graph Main view 96. The gaze cursor in the Line Graph Miniview 99 will jump to the position at the start time of the event.

Events
Type Eye Index Start (ms) Duration (ms)
User Message 1 0 0
Fixation Right 1 2 134
Fixation Left 1 2 134
Saccade Left 1 137 19
Saccade Right 1 137 19
Fixation Right 2 156 659
Fixation Left 2 156 483
Fixation Left 3 676 139
Blink Left 1 1353 99
Blink Right 1 1353 119
Blink Left 2 14051 119
Blink Right 2 15564 119
Blink Left 3 15564 119

A highlighted event in the **Events** list. The marked event is framed by two cursors in the Graph Area:

The gaze cursor (blue dot in the full view, a cross in the zoomed view) is at the start time of the event in the Miniview:

Line Graph Overview 93

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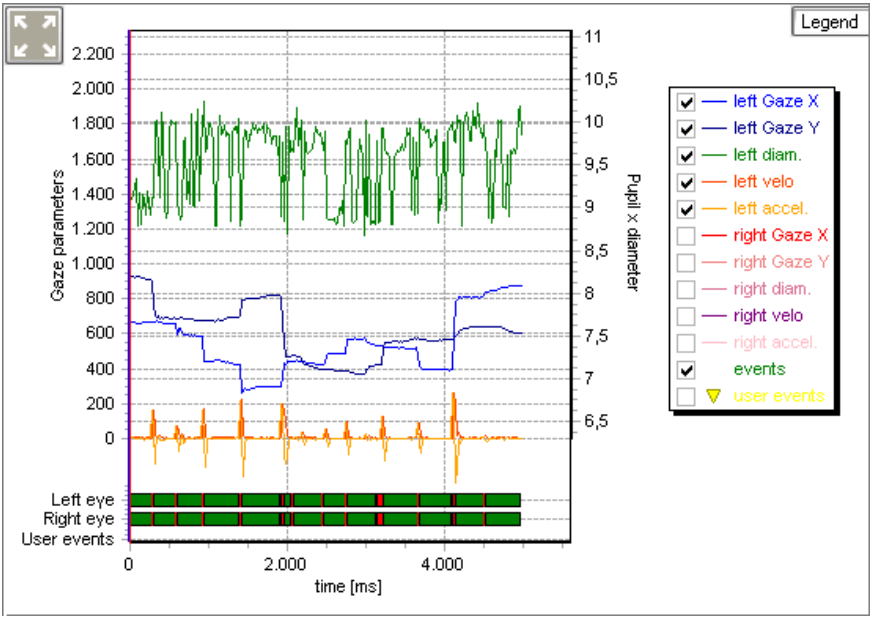
6.5.3 Graph Area

In the **Line Graph** main view, the following gaze data will be visualized over the timeline:

- **Gaze parameters:** The Y-axis at the left displays the gaze position in the stimulus (x- and y-direction) as well as angular velocity and acceleration of the eye.
- **Pupil diameter**: The Y-axis at the right displays the pupil diameter.
- **Time [ms]**: The X-axis at the bottom displays fixations, saccades, blink, and user events.

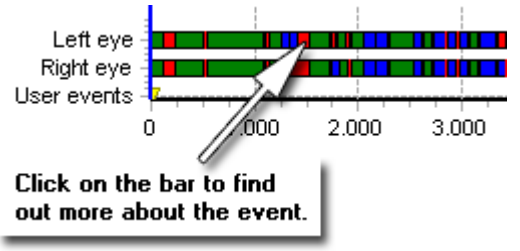


You can customize the line graph display with the following steps:

1. Right click the line graph display to open a context menu. Select the **Settings** command and change line colors and display in the Line Graph Settings Dialog 100.

2. Click the **Reset Scaling** icon in the top left corner to revert display scaling and positioning.
3. Click the **Legend** button in the top right corner to hide or unhide the legend.

   If the legend is displayed, activate or deactivate the options next to the labels. This selects the desired combination of lines to draw.
4. To shift the line graph display scales, drag the left or right Y-axis or drag the bottom X-axis using the finger mouse cursor. To shift the line graph position, hold down the [SPACE] key and drag the display using the hand mouse cursor.
5. To zoom in, simply click into the display. To zoom an arbitrary display portion, click and drag to span a dotted zoom box. If you release the mouse button, the display is zoomed accordingly.
6. To zoom out, hold down the [CTRL] key and click into the display.
7. Click the colored event bar displayed at the bottom of the line graph display. This selects a single event and moves the Line Graph Diagram Cursors 98 as well. The respective event is highlighted in the Events Selection, 57 view, which in turn also updates the Trial Details 55 view and the Line Graph Miniview 99. Note, that you can manually drag the diagram cursors using the drag mouse cursor.



8. In the **Export** menu, either select the **Save image to file** ([CTRL] + [S]) or select the **Copy image to clipboard** ([CTRL] + [C]) keyboard command to export the current line graph display to a single image.

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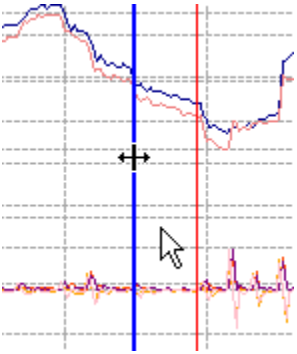
6.5.4 Diagram Cursors

If you create a new Line Graph, you will find a blue vertical line in the middle of the Graph Area, the main data cursor. The data cursor is movable, you can drag it to every time in the Graph Area. Simply hover with the mouse over the data cursor until a double slider becomes visible, then click the left mouse button and drag the data cursor to the desired position. Alternatively, you can use the arrow left / arrow right keys on the keyboard.



The data cursor can be used to find out the exact values for the gaze data at a particular time. The gaze data values are displayed in the Data Table 98 and are immediately updated for the current data cursor position. Furthermore, the gaze point at this time on the stimulus image is displayed in the Miniview 99 below the Graph Area.

Apart from the data cursor a red auxiliary cursor is visible.

6.5.5 Data Table

In the data table, the data values are displayed numerically for the current Line Graph Diagram Cursor 98 positions. You will find information about:

- the exact time for the time cursor positions.
- the pupil diameter at this time

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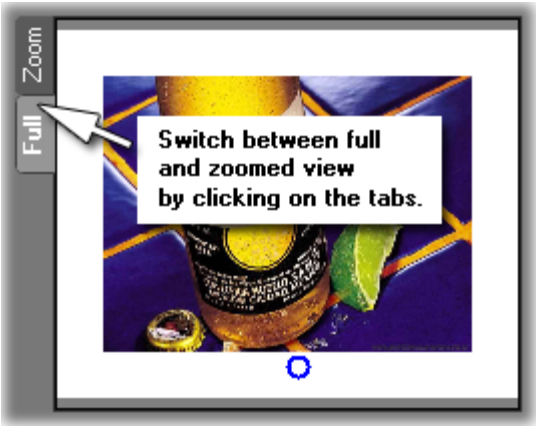
- the gaze point in x- and y-direction in [pixels]. (0,0) is the upper left corner of the stimulus image.
- the angular speed of the eye
- the angular acceleration of the eye

If you work with binocular data, the values for both eyes will be displayed.

6.5.6 Miniview

In the **Miniview**, the gaze position at the current data cursor 98 is displayed in the stimulus. The Miniview offers two display tabs:

- **Full** tab: shows the complete and resized stimulus.
- **Zoom** tab: shows a magnified area around the gaze position.



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6.5.7 Settings

In the **Linegraph Settings** dialog, you select line colors, event colors and customize the line graph chart settings.

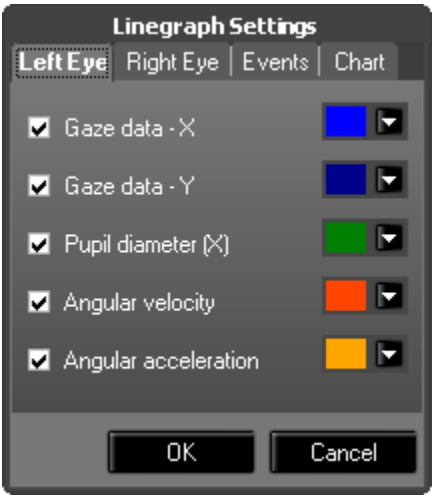
1. Right click into the Line Graph Main Pane 96 to open a context menu. Select the **Settings** command.

   The **Linegraph Settings** dialog opens.

2. Switch to one of the available dialog tabs and change settings.
3. Confirm your settings with **OK**.

The following dialog tabs are available.

Left Eye

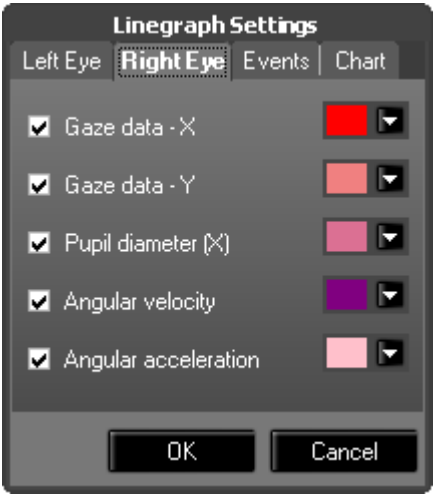


In this tab you can configure, for left data channel the color and the visibility of:

- gaze data on X
- gaze data on Y
- pupil diameter

- angular velocity
- angular acceleration

Right Eye



In this tab you can configure, for right data channel the color and the visibility of:

- gaze data on X
- gaze data on Y
- pupil diameter
- angular velocity
- angular acceleration

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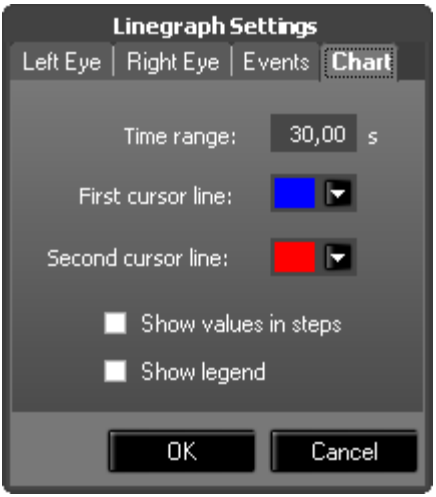
Events

In this tab you can configure the color for the following types of events:

- fixation
- saccade
- blink
- user event

Chart



In this tab you can configure:

- the time range in [s]
- the color of the first cursor line
- the color of the second cursor line
- whether to show values in steps
- whether to show the legend

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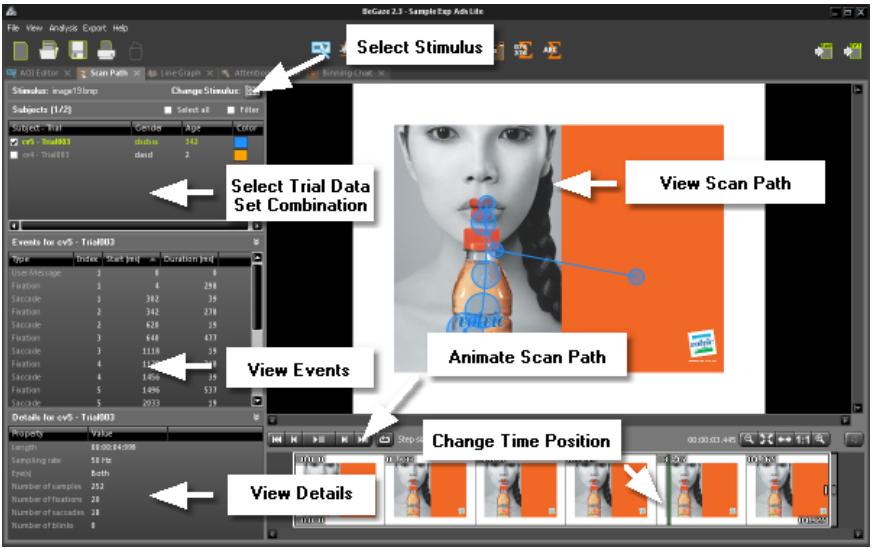
6.6 Scan Path

6.6.1 Overview

The **Scan Path** data view shows gaze positions of the selected trial data set is plotted on the stimulus image or video.



Operate the **Scan Path** data view with the following steps:

1. Use the Stimulus Selection 51 to change to the desired stimulus.

   The Subjects Selection 52 displays matching subjects together with their trial gaze data sets.

2. In the Subjects Selection 52, activate the desired trial or filter combination.

   The Scan Path Main Pane 106 is updated and shows the scan path for the activated trial combination.

   While selecting trials, the Events Selection 57 view and the Trial Details 55 view shows information about the currently selected trial or

event.

3. If you click on an event in the **Events** selection view, the corresponding event is automatically selected in the main view.
4. Select the scan path time position in the Thumbnail Control 64. Use the Playback Control 62 to view an animated scan path.
5. You can export the animated scan path display to an AVI file. From the **Export** menu, select the **Export Scan Path Video** command.

   Alternatively, you can export the current view of the scan path to an image file. From the **Export** menu, select the **Save Image to File…** command.

All features of this data view are available with gaze tracking data generated with the iView X™ system. Note that the type of stimuli (still images and/or videos) which can be analyzed depends on the acquired BeGaze 2.3 program version 11.

Screen recording experiments and HED videos are only compatible with gaze tracking data which have been generated with the iView X™ version 2.1 or higher.

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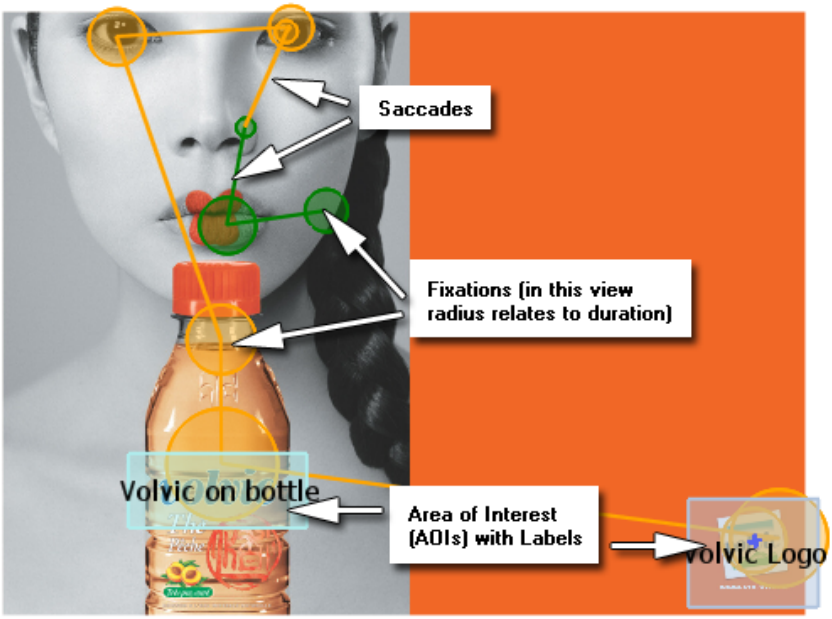
6.6.2 Main Data View

The **Scan Path** main view visualizes the selected trial data set as a 2D plot over the stimulus image or video. The following image shows an example for a fixation and saccade plot with dynamic fixation radius and AOIs:


Saccades
Fixations (in this view radius relates to duration)
Volvic on bottle
Area of Interest (AOIs) with Labels
Volvic Logo

Generally, you can select to plot either raw data or to plot fixations and saccades. If you select to plot fixations and saccades, a fixation point is displayed in the center of a circle and the saccades are plotted as connecting lines in-between. It is also possible to configure a fixed circle radius or a circle radius that relates to the fixation duration. A fixation counter can also be displayed in the center of the fixation circle.

You can change the scan path display with the following steps:

1. Right click the scan path display to open a context menu.

2. Select the **Settings** command to display the Scan Path Settings 109 dialog. In the **Scan Path** tab, select between **Fixations** or **Raw data** display. Change other settings as well and confirm with **OK**.

   The scan path display is updated.

3. Select the **Show AOIs** command, to toggle the visibility of AOIs in the scan path display.

4. In the **Export** menu, either select the **Save Image to File** ([CTRL] + [S]) or select the **Copy Image to Clipboard** ([CTRL] + [C]) keyboard command to export the current scan path display to a single image. You can also export the scan path to a video file using the **Export Scan Path Video** command from the **Export** menu.

Select Events

If you click on a fixation circle or on a saccade line, the clicked item will be highlighted. At the same time the corresponding subject and event will be highlighted in the Subjects Selection 52 and the Events Selection 57. The subject and event will be highlighted when clicking on raw data cursors also.

Highlighted event in the **Events** selection:

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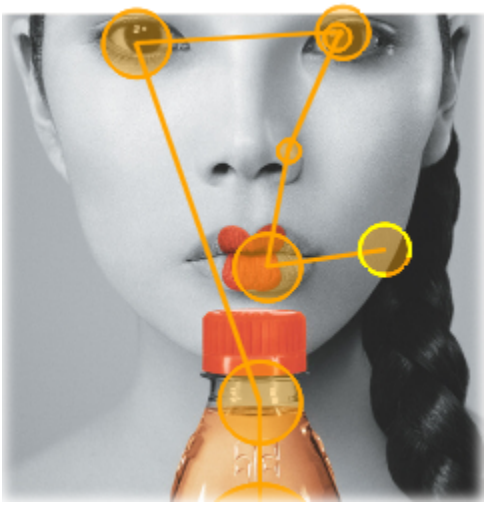
Events

Type	Index	Start (ms)	Duration (ms)
User Message	1	0	0
Fixation	1	17	338
Saccade	1	355	39
Fixation	2	395	457
Saccade	2	852	20
Fixation	3	872	159
Saccade	3	1032	19
Fixation	4	1052	179
Saccade	4	1231	19
Fixation	5	1251	358
Saccade	5	1609	19
Fixation	6	1629	457

Highlighted fixation in the **Scan Path** display:



The scan path is drawn in the color of the corresponding subject unless special timers are defined in the Scan Path Settings 109.

Modify subject properties

If required, you can edit the subject properties displayed in the Subjects Selection 52 view. Click the desired property and overwrite its content.

6.6.3 Settings

6.6.3.1 View Settings Dialog

In the **View Settings** dialog, you can change the scan path display to your needs.

1. Right click the Scan Path Main Pane 106 to open a context menu.
2. Select the **Settings** command to open the **View Settings** dialog.
3. Switch to one of the following tabs and change settings:

   – In the Scan Path Tab 109 you can change the general appearance of the scan path display.

   – In the Cursor Tab 111 you configure the gaze cursor appearance.

   – In the Fixations Tab 113 you adapt the fixations display.
4. Confirm your settings with **OK**.

If you open a second Scan Path 104 data view, the new data view will inherit the current view settings. If you adapt the view settings of the second data view, you can switch between the two different scan path views very fast.

6.6.3.2 Scan Path Tab

In the **Scan Path** tab of the Scan Path Settings 109 dialog, you configure the general appearance of the scan path display.

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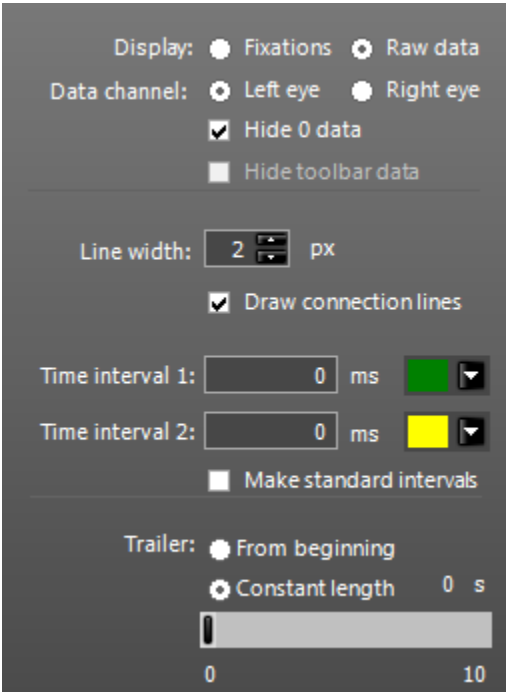

- **Display**: Select if you want to view **Fixations** or **Raw data**. To view saccades as well, enable the **Trailer** option (see below).
- **Data channel**: Select if you want to view **Left eye** or **Right eye** data. If the currently selected trail data set only has monocular gaze data, the available data channel is selected automatically.
- **Hide 0 Data**: The gaze tracker produces data with position (0,0) if – for some reason – gaze tracking was lost during the recording. Activate the **Hide 0 Data** option to hide these artifacts. This option is enabled by default.
- **Hide toolbar data**: This option applies to web stimuli only. Activate this check box if you want to hide the gaze data which are located on the web toolbar of the stimulus from the scan path.
- **Line width**: Select the line widths for the scan path lines (in pixels).

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- **Draw connection lines**: Activate this option, if raw data should be connected with lines. This option is enabled by default.
- **Time interval**: You can define two intervals in which the scan path should be plotted in a different color. After these intervals ended, the scan path plot continues with the defined subject color property in the **Subjects** list view. Activate the **Make standard intervals** option if the scan path plot should continue with alternating intervals according to the time interval definition.
- **Trailer**: Determines, how many gaze data is accumulated to display fixations and saccades. Note that the following settings relate to the time window you have set in the Thumbnail Control 64.

  From beginning (still image stimulus only): If activated, all gaze data is displayed from the first sample to the current analysis position.

  Constant length: If activated, the current analysis position leaves "a trail behind". This means: a certain time window of gaze data – which immediately precedes the current analysis position – is displayed. Use the slider to change the length of time window from 0 seconds up to 10 seconds.

If you display an overlay of the real-time gaze positions of multiple subjects, this is called the "bee swarm" mode. To activate this display mode, enable the Raw Data display and configure the trailer with a Constant length of zero. Select multiple subjects / trials and press play.

6.6.3.3 Cursor Tab

In the **Cursor** tab of the Scan Path Settings 109 dialog, you configure the gaze cursor appearance.

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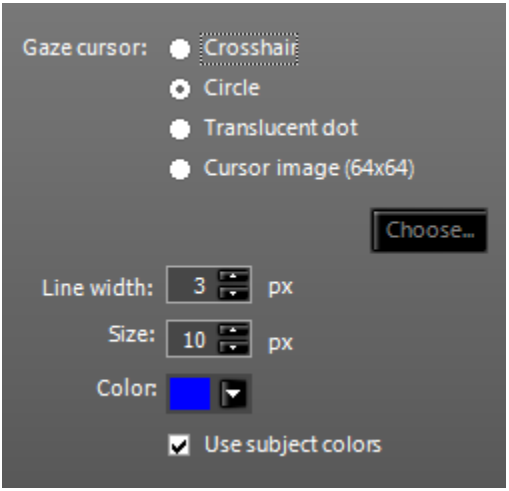

- **Gaze cursor**: Configures the appearance of the shape that shows the current gaze position. You can switch between a **Crosshair**, a **Circle**, and a **Translucent dot** shape.

  It is also possible to use a 64x64 pixel bitmap as customized shape. Switch to **Cursor image** and click the **Choose...** button to select a suitable external bitmap graphics file.

- **Line width** (not used with **Cursor image** setting): Changes the line width of the gaze cursor (in pixels).

- **Size** (not used with **Cursor image** setting): Changes the diameter of the gaze cursor (in pixels).

- **Color** (not used with **Cursor image** setting): Changes the gaze cursor color. Click the drop-down icon and select the desired color.

- **Use subject colors**: If checked overrides the **Color** setting above and sets the gaze cursor color to the subject color property in the **Subjects** list view. The default state is checked.

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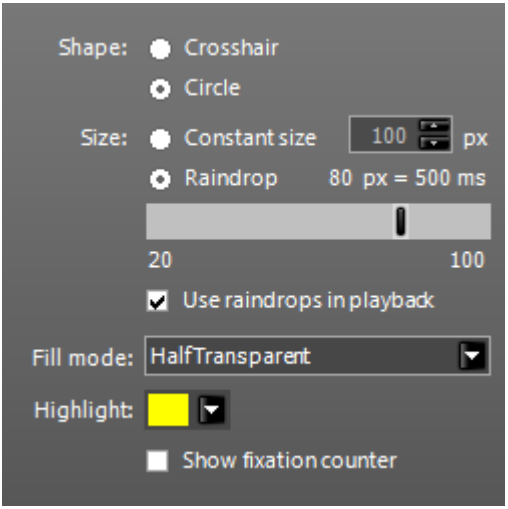
6.6.3.4 Fixations Tab

In the **Fixations** tab of the Scan Path Settings 109 dialog, you configure how fixations are plotted on the scan path display. The following settings only apply if you have activated the **Fixations** option in the Scan Path Settings – Scan Path Tab 109.



- **Shape**: Selects between a **Crosshair** and a **Circle** shaped fixation display.
- **Size**: Determines the fixation shape size.

  Constant size: If checked, the size of the fixation shapes is constant. You can change the shape's size (in pixels).

  Raindrop: If checked, the size of the fixation shape is proportional to the fixation duration. On the slider, you can set how many pixels represent a 500 ms fixations.
- **Use raindrops in playback**: If checked, the radius of the fixation shapes also changes during replay or while moving the current analysis position.
- **Fill Mode**: Selects the fixation shape fill mode: **Hatched**, **Half Transparent** or **Transparent** fills are supported.

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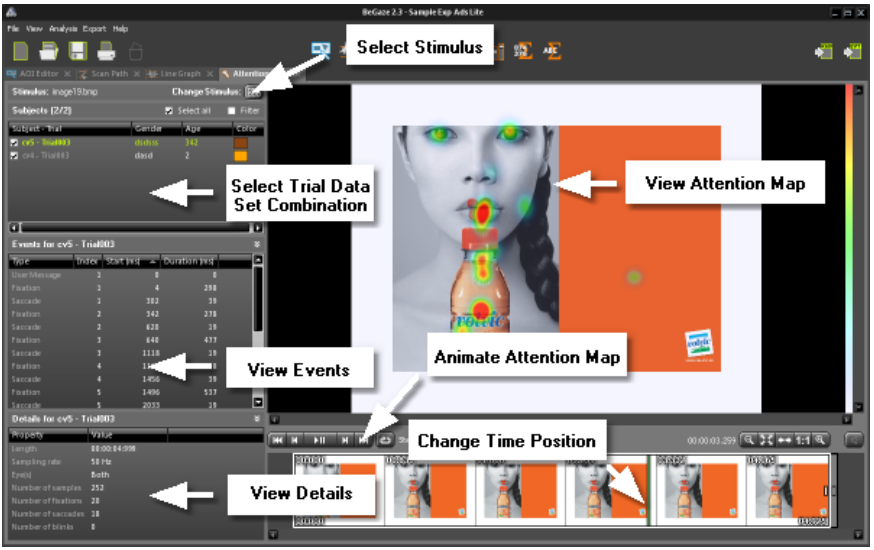
- **Highlight**: Selects the highlight color for the fixation shape. Click the drop-down icon and select the desired color.
- **Show fixation counter**: Counts up the fixations and indicates a counter for each fixation.

6.7 Attention Map

6.7.1 Overview

With the **Attention Map** data view, gaze patterns are visualized by altering the color / brightness / transparency of the stimulus display based on the amount of attention received.



Operate the **Attention Map** data view with the following steps:

1. Use the Stimulus Selection 51 to change to the desired stimulus.

   The Subjects Selection 52 displays matching subjects together with their trial gaze data sets.

2. In the Subjects Selection 52, activate the desired trial or filter combination.

   The Attention Map Main Pane 115 is updated and shows the attention map for the activated trial combination.

   While selecting trials, the Events Selection 57 view and the Trial Details 55 view shows information about the currently selected trial or event.

3. If you click on an event in the **Events** selection view, the corresponding event is automatically selected in the main view.
4. Select the attention map time position in the Player Control 61. Use the Playback Control 62 to view an animated attention map.
5. You can export the animated attention map display to an AVI file. From the **Export** menu, select the **Export Attention Map Video** command.

   Alternatively, you can export the current view of the attention map to an image file. From the **Export** menu, select the **Save Image to File…** command.

All features of this data view are available with gaze tracking data generated with the iView X™ system. Note that the type of stimuli (still images and/or videos) which can be analyzed depends on the acquired BeGaze 2.3 program version 11.

Screen recording experiments and HED videos are only compatible with gaze tracking data which have been generated with the iView X™ version 2.1 or higher.

6.7.2 Main Data View

After selecting the desired trial data, the **Attention Map** main view displays the updated map. Three visualization styles are possible:

- The **Heat map** shows fixation hits related to the color scale between violet (less hits) and red (most hits).

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- The **Focus map** shows fixation hits related to brightness between darkest (less hits) and normal brightness (most hits).

- The **Custom map** shows fixation hits related to a custom defined color scale.

Note, that the data interpretation differs with the stimulus type. The map displayed for a still image stimulus is based on fixations while

the map displayed for a video stimulus is based on raw data.

Change the attention map display

To change the attention map display settings proceed as follows:

1. Right click the map display to open a context menu.
2. Select the **Settings** command to display the Attention Map Settings 117 dialog. Select the map style and confirm with **OK**.

   The attention map display is updated.
3. Select the **Show AOIs** command, to toggle the visibility of AOIs in the map display.
4. In the **Export** menu, either select the **Save Image to File** ([CTRL] + [S]) or select the **Copy Image to Clipboard** ([CTRL] + [C]) keyboard command to export the current attention map display to a single image. You can also export the attention map to a video file using the **Export Attention Map Video** command from the **Export** menu.

Modify subject properties

If required, you can edit the subject properties displayed in the Subjects Selection 52 view. Click the desired property and overwrite its content.

6.7.3 Settings

In the **View Settings** dialog, you can configure the visualization style and parameters of the **Attention Map**.

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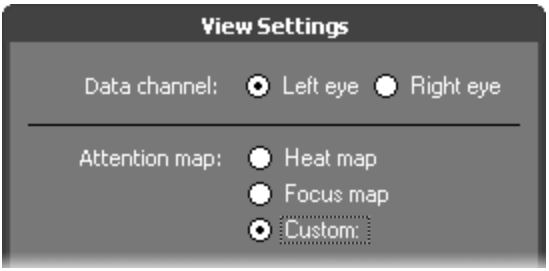
General Settings



- **Data channel**: Select if you want to view left or right eye. In case of monocular gaze data files, the available data channel is selected automatically.
- **Attention map**: Select if you want to see a **Heat map**, a **Focus map** or a **Custom** map.

Note, that the Saturation parameter (see below) is available for any map type while the color parameter settings in the dialog are available for the Custom map only.

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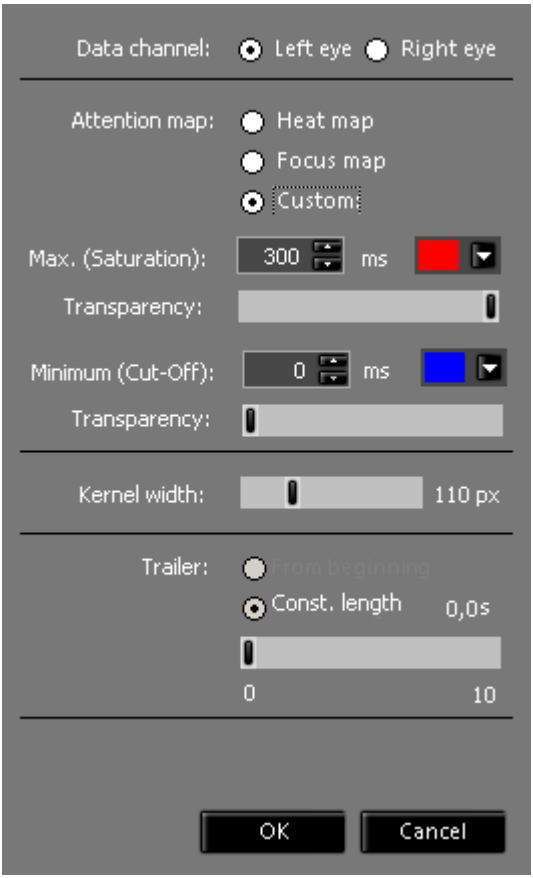
Parameters



- **Max. (Saturation):** For every pixel displayed on the map, the fixation duration is counted and integrated over time. For multiple subjects, the sum (over all subjects) of the fixation duration is calculated. The setting defines the maximum duration of the scale; if this value is reached or exceeded the matching image pixels will be drawn with the highest value, which is

  – red for the Heat map,

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– normal brightness for the Focus map,

– a customized color for Custom map style

Changing this parameter is useful if you are interested in fixations that exceed a specific fixation duration. Use the **Transparency** slider to change the transparency style if required.

- **Minimum (Cut-Off)**: For every pixel displayed on the map, the fixation duration in milliseconds is counted. The setting defines the minimum duration of the scale. If this value is not reached, the matching image pixels will be drawn with the lowest value, which is

  – blue for the Heat Map,

  – no brightness for the Focus Map,

  – a customized color for the Custom Map.

  Use the **Transparency** slider to change the transparency style if required.

- **Kernel width**: To calculate the Attention Map, all fixation hits are filtered with a Gaussian filter. This setting defines the width (in pixels) of the Gaussian curve. If you decrease the value, the analysis resolution will increase. At the same time, the hot spots will become smaller and more spread.

- **Trailer**: Determines, how many gaze data is accumulated to display fixations. Note that the following settings relate to the time window you have set in the Thumbnail Control 64.

  From beginning (still image stimulus only): If activated, all gaze data is displayed from the first sample to the current analysis position.

  Constant length: If activated, the current analysis position leaves "a trail behind". This means: a certain time window of gaze data – which immediately precedes the current analysis position – is displayed. Use the slider to change the length of time window from 0 seconds up to 10 seconds.

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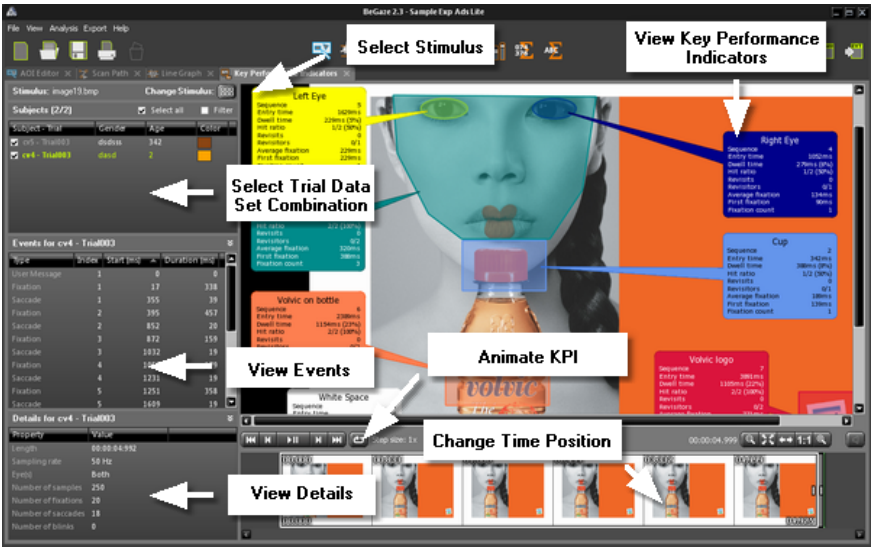
6.8 Key Performance Indicators

6.8.1 Overview

With the **Key Performance Indicators** data view, a number of important statistical indicators are visualized in text bubbles associated to each AOI. The statistical data is updated in realtime and reflects the selected subjects in the Subjects list view.



Operate the **Key Performance Indicators** data view with the following steps:

1. Use the Stimulus Selection 51 to change to the desired stimulus.

   The Subjects Selection 52 displays matching subjects together with their trial gaze data sets.

2. In the Subjects Selection 52, activate the desired trial or filter combination.

   The Key Performance Indicators Main Pane 122 is updated and shows

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the KPIs for the activated trial combination.

While selecting trials, the Events Selection 57 view and the Trial Details 55 view shows information about the currently selected trial or event.

3. If you click on an event in the **Events** selection view, the corresponding event is automatically selected in the main view.
4. Select the KPI time position in the Player Control 61. Use the Playback Control 62 to view the KPIs in real time.
5. You can export the animated KPI display to an AVI file. From the **Export** menu, select the **Export KPIs Video** command.

   Alternatively, you can export the current view of the KPIs to an image file. From the **Export** menu, select the **Save Image to File…** command.

All features of this data view are available with gaze tracking data generated with the iView X™ system. Note that the type of stimuli (still images and/or videos) which can be analyzed depends on the acquired BeGaze 2.3 program version 11.

Screen recording experiments and HED videos are only compatible with gaze tracking data which have been generated with the iView X™ version 2.1 or higher.

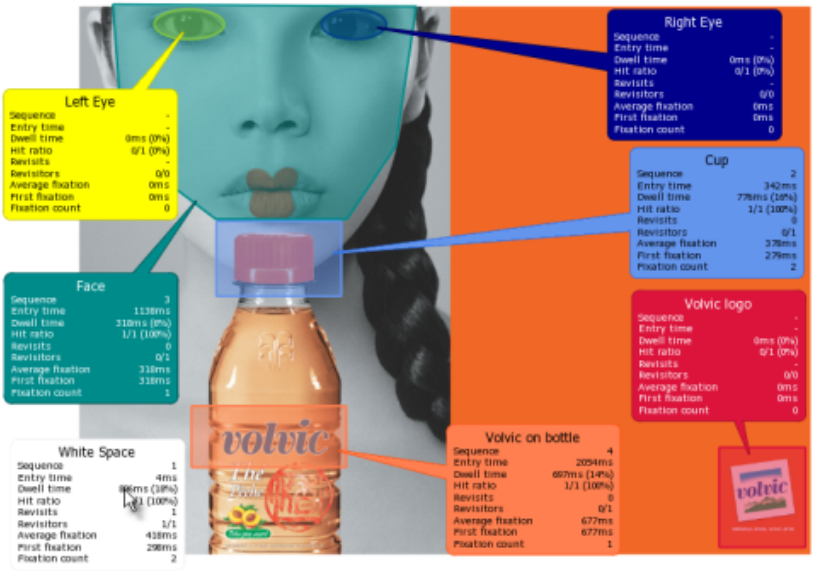
6.8.2 Main Data View

The **Key Performance Indicators** (KPI) main view gets you immediate responses at a glance:

- Which stimuli elements were the eye catchers?
- How many subjects watched each element?
- In which order?
- How many revisits?
- What is the rank and share of visual attention among all subjects?

- and more ...

It makes the results quantitative AND visible!



KPI functionalities and handling

- Works with still images and video clips, on websites or screen recording videos
- Displayed as overlay on Areas of Interest (AOI) visualization
- Interactive information updated based on selected subjects (individual, groups, all) and time of regard
- Select and deselect KPI windows, move their position freely
- Export visualization as BMP or AVI for your exposé, report, documentation etc.
- A White Space KPI exists for still image stimuli only and shows indicators for the area left outside of the AOIs

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Change the KPI display

To change the KPI display settings proceed as follows:

1. Right click the main view to open a context menu.
2. Select the **Settings** command to display the KPI Settings 124 dialog. Select the indicators to display and confirm with **OK**.

   The KPI display is updated.
3. In the **Export** menu, either select the **Save Image to File** ([CTRL] + [S]) or select the **Copy Image to Clipboard** ([CTRL] + [C]) keyboard command to export the current KPI display to a single image. You can also export the KPIs to a video file using the **Export KPIs Video** command from the **Export** menu.

Modify subject properties

If required, you can edit the subject properties displayed in the Subjects Selection 52 view. Click the desired property and overwrite its content.

6.8.3 Settings

In the **View Settings** dialog, you can select which indicators to show in the **Key Performance Indicators** data view.

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General Settings

- **Data channel**: Select if you want to view left or right eye. In case of monocular gaze data files, the available data channel is selected automatically.

Indicators

The available key performance indicators and their meaning are described in the table below:

KPI Name	unit	Description
Sequence	count	Order of gaze hits into the AOIs based on Entry time, lowest entry time = first in Sequence
Entry	ms	Average duration for the first fixation into

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time		the AOI
Dwell time	ms and %	Dwell time average ms = sum (all fixations and saccades within an AOI for all selected subjects) / by number of selected subject Dwell time average % = dwell time average * 100 / (current time - start time)
Hit ratio	count and %	How many subjects out of the selected subjects looked at least one time into the AOI - "total hit count" / "number of selected subjects"
Revisits	count	Average Revisits = (Number of glances divided by selected subjects with at least one visit) -1 Glances = Increments the counter each time a fixation hits the AOI if not hit before
Revisitors	count	1. Number of subjects with more than one visit in an AOI 2. Total number of subjects with at least one visit into an AOI e.g. 3 revisitors out of 7 visitors
Average Fixation	ms and %	Sum of "average fixation time per subject in an AOI" divided by number of selected subjects
First fixation	ms	Sum of all "first fixations" for selected subjects divided by number of selected subjects
Fixation count	count	Number of all fixations for selected subjects divided by number of selected subjects

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Font

- **Font Size**: Selects the size of the KPIs font as a percent of the standard font size used for the main view (the font size used for AOI names in the AOI Editor for example).
- **Fixed Size**: If checked the KPI font size remains the same at all zoom levels, otherwise the font size scales together with the AOIs at different zoom levels. Default is not checked.

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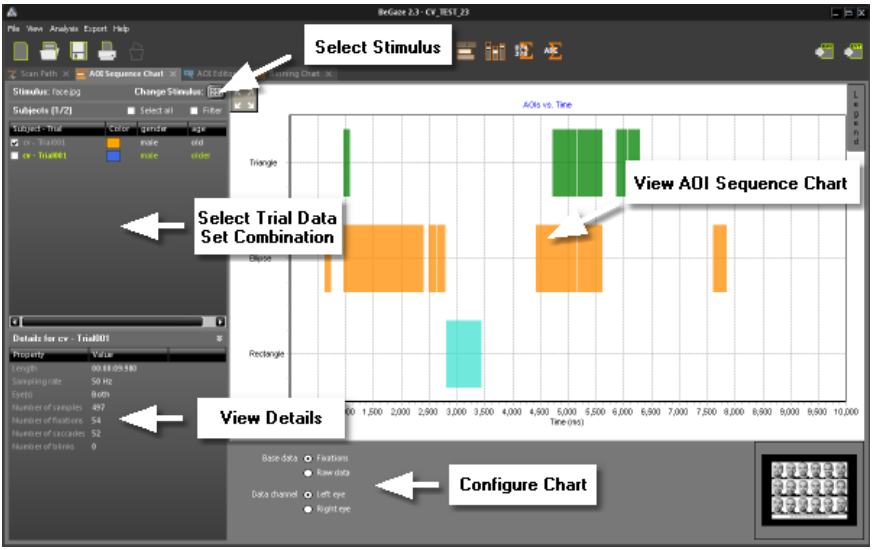
6.9 AOI Sequence Chart

6.9.1 Overview

The **AOI Sequence Chart** shows the temporal order at which AOIs were hit by a particular subject.



Operate the **AOI Sequence Chart** data tab with the following steps:

1. Use the Stimulus Selection 51 to change to the desired stimulus.

   The Subjects Selection 52 displays matching subjects together with their trial gaze data sets.

2. In the Subjects Selection 52, select one or multiple trials.

   The AOI Sequence Chart Main View 129 is updated and shows the AOI hits for the selected trial.

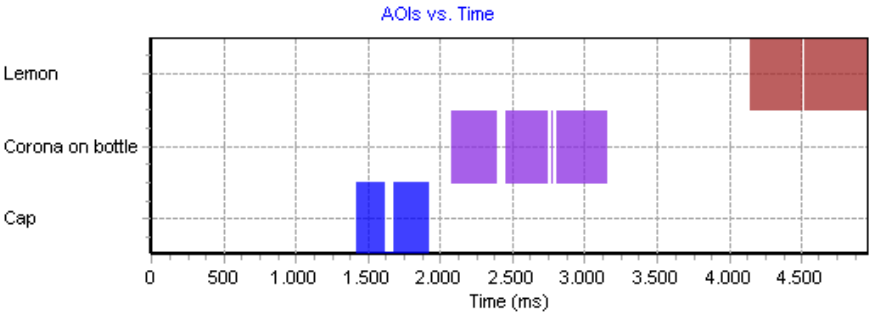
   While selecting trials, the Trial Details 55 view shows information about the currently selected trial.

3. Configure the Chart Display Modes 67 to further adapt the display to your needs.

6.9.2 Main Data Tab

Single Subject Selection

After selecting the desired trial data, the **AOI Sequence Chart** main view displays the updated chart. The following image shows the display for a still image stimulus.



The colored bars represent the different AOIs hits. If the AOIs are labeled, their names appear at the y-axis. The x-axis shows the time in milliseconds. If you right click on one of the bars, a tooltip will pop up displaying detailed information on the AOI (name, start / end time of it's presentation, and the duration of the AOI presentation).

In the example above the selected subject was looking at the AOI labeled "Cap" (colored in blue), then the gaze switches to the AOI labeled "Corona on bottle" (colored in violet).

For video stimuli, the display also indicates when a specific AOI has the visibility property set. In the example below, the AOI labeled "Bee" is visible ("active") from start until the 24th second while the AOI labeled "SMS" starts invisible ("not active") and gets visible around the 16th second.

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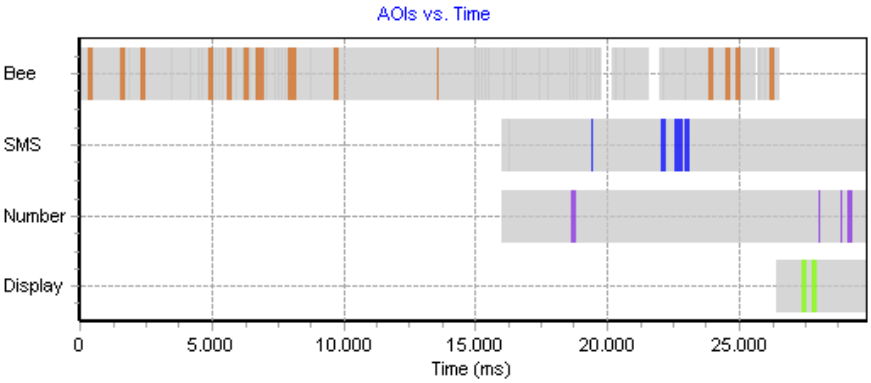
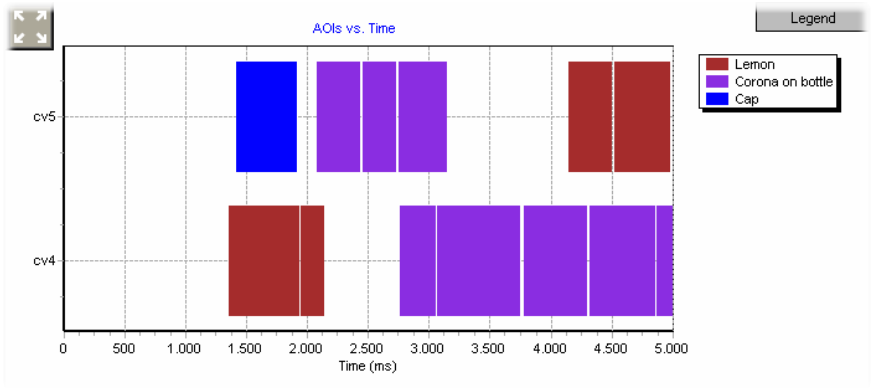


You can change the AOIs and also change the AOI colors in the AOI Editor 68.

Multiple Subject Selection

After selecting the desired trial data, the **AOI Sequence Chart** main view displays the updated chart. The representation is the same for still images and video stimuli.



The colored bars represent the different AOIs hits. If the AOIs are labeled, their names appear at the Legend. The x-axis shows the time in milliseconds. If you right click on one of the bars, a tooltip will pop up

displaying detailed information on the AOI (name, start / end time of it's presentation, and the duration of the AOI presentation).

In the example above the selected subject was looking at the AOI labeled "Cap" (colored in blue), then the gaze switches to the AOI labeled "Corona on bottle" (colored in violet).

Click the **Reset Scaling** icon in the top left corner to revert display scaling and positioning.

Click the **Legend** button in the top right corner to hide or unhide the legend.

Modify subject properties

If required, you can edit the subject properties displayed in the Subjects Selection 52 view. Double click the desired property and overwrite its content.

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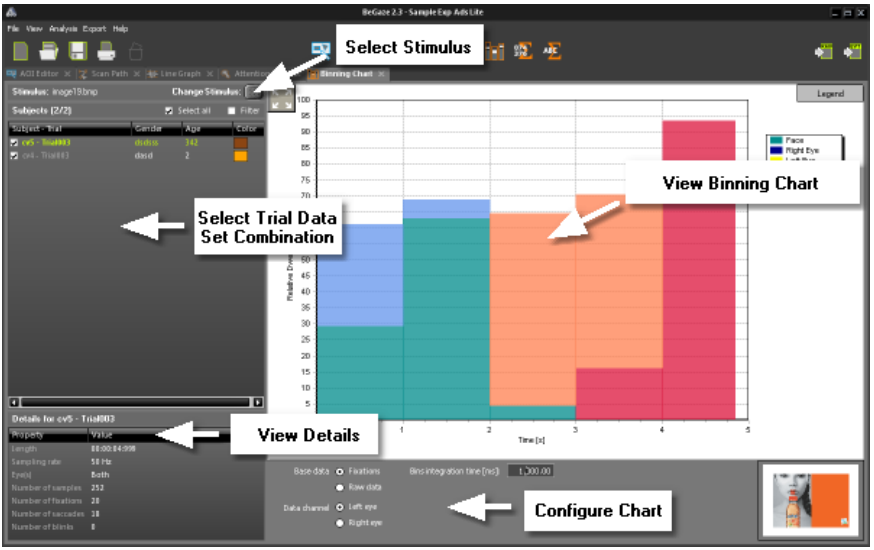
6.10 Binning Chart

6.10.1 Overview

The **Binning Chart** shows a statistical overview of AOI hits for separated time slices (bins). For each time slice, the AOI hit percentages for all selected trials are summarized and displayed as stacked column.



Operate the **Binning Chart** data view with the following steps:

1. Use the Stimulus Selection 51 to change to the desired stimulus.

   The Subjects Selection 52 displays matching subjects together with their trial gaze data sets.

2. In the Subjects Selection 52, activate the desired trial or filter combination.

   The Binning Chart Main Pane 133 is updated and shows the AOI hit percentages for the activated trial combination.

   While doing this, the Trial Details 55 view shows information about the

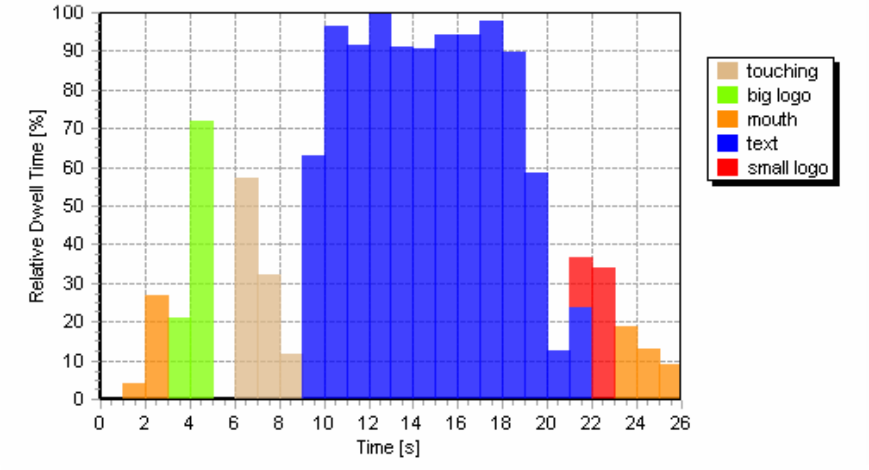
currently selected trial.

3. Configure the Chart Display Modes 67 to further adapt the display to your needs.

You can change the time slice granulation in the configuration area available below the main display area. You can change the Bins integration time [ms] setting from sampling frequency (e.g. 20ms for 50Hz data) up to 60 seconds.

6.10.2 Main Data Tab

After selecting the desired trial data, the **Binning Chart** main view displays the updated chart.



The AOI hit percentages are presented using different colors. The legend below the chart shows which colors are used.

In the above example between the 20th and 21st second the "text" AOI was hit at about 14%, whereas all other AOIs were not hit in this time slice. In the next second another AOI ("small logo") was also hit.

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You can change the AOIs and also change the AOI colors in the AOI Editor 68.

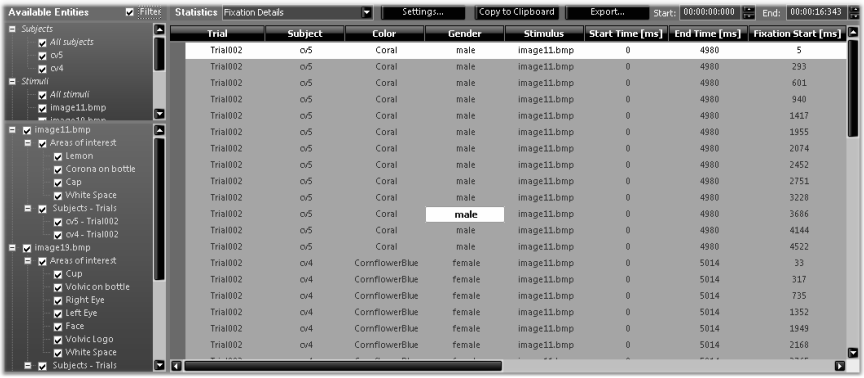
Modify subject properties

If required, you can edit the subject properties displayed in the Subjects Selection 52 view. Double click the desired property and overwrite it's content.

6.11 Event and Reading Statistics

6.11.1 Overview

The **Event Statistics** and **Reading Statistics** data tabs presents information and statistics regarding gaze tracking events. The data view's main view consists of different parts identified in the image below.



You operate the **Event Statistics** and **Reading Statistics** data views with the following steps. While doing so, the Results Grid 140 updates in real-time displaying the outcome of your selections and settings.

1. Use the **Selection Tree** displayed to the lower left to select the stimuli, trials, and areas of interest for statistic analysis. To narrow down or

qualify your selection, enable the **Filter** option to display the **Filter Tree** (upper left). See Statistics Selection Trees 135 for an in depth explanation.

2. Choose the desired **Statistics Template** from the Statistics selection box. The list offers both predefined and user defined templates. You may duplicate and change a predefined statistics template. See Statistics Template 137 for an in-depth explanation.
3. Press **Settings** button to select or deselect cells from the template, to create own templates and switch between evaluation of **Left eye** or **Right eye** gaze tracking data
4. As an option, you may specify the desired Time Interval 139. Furthermore, it is also possible to re-arrange the columns, sort the data or only show columns of your interest within the Results Grid 140.
5. If the display suits your requirements, click Export to write the current display to a file. See Export Statistics 140 for details.
6. Click on **Copy to Clipboard** button to copy the current shown statistic into the clipboard for further use in other programs, e.g. MS-Excel.

The statistics display is calculated in real-time. Depending on the complexity of the experiment and on the computer performance, the calculation might take some time.

The Reading Statistics 182 data view is available when the Reading Package is licensed.

6.11.2 Selection Trees

Selection Tree

The **Selection Tree** is used to select the stimuli, trials and areas of interest for which the **Event Statistics** data view outcome is computed. Using the selection tree is straightforward:

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1. The top level (root) nodes selects or de-selects stimuli available in the current experiment. To help in the selection, a thumbnail of the stimulus is displayed as tooltip when you hover the mouse over the respective screen region.
2. If you enable or disable a node, all child nodes follow that selection. For example: to de-select all child entries associated below a specific stimulus, disable the corresponding top level node.
3. On the tree's second level, you select or de-select statistics for all **Areas of interest** or statistic entries for all **Subjects – Trials**. Note, that you can narrow down the selection of subjects and trials with the **Filter Tree** (see below).
4. On the tree's third level, you select a specific combination of AOIs or a specific combination of trials. A "white space" AOI is generated to cover all areas left outside of defined AOIs.

Once a selection is made, the results are computed and displayed in the Results Grid 140 immediately.

Filter Tree

With the **Filter Tree**, a specific set of trials / subjects can be selected. This is especially helpful, if you have a large number of trials or if you want to select trials / subjects by additional subject properties collected while running the experiment.

1. Activate the **Filter** option above the **Selection Tree**.

   A separate tree view opens. The new tree view lists all **Subjects** as well as customized subject properties as top level experiment. Note, that customized subject properties (for example **Gender** or **Age**) need to be defined when creating the experiment using SMI Experiment Center. When running the experiment, these properties are available for operator input when starting a new trials.
2. Open the available top level nodes and select the desired combination of **Subjects** or customized subject properties. For example: if your experiment includes the subject property **Gender**, you are now able to select trials linked to male or female subjects.

   The selected filter combination is applied. The results are computed

and displayed in the Results Grid 140 immediately. Note, that the selection in the **Filter Tree** is independent from the selection already made in the **Selection Tree**. For this reason, already de-selected items from the **Selection Tree** may show up in the **Results Grid** now.

3. After doing the selection in the **Filter Tree**, you can de-select items in the **Selection Tree** to temporarily hide specific items from the **Results Grid**.
4. Deactivate the **Filter** option to switch off the settings made in the **Filter Tree**.

Switch between tooltip view of AOI and AOI preview

1. To switch between the tooltip view of an AOI and the AOI preview, press [CTRL] + [T].

6.11.3 Template List

For optimized handling of the large count of statistical data items, BeGaze 2.3 groups them as **Statistic Templates**. Each statistic template covers a specific purpose. For details about the predefined templates see Statistics Definitions and Examples 142.

To operate the statistics templates, proceed as follows:

1. Select an item from the **Statistic Templates** list.

   This will activate a set of statistic items, which are computed and displayed in the Results Grid 140 immediately.
2. After activating the desired template, you can modify the **Results Grid** to suit your needs. This can be done by

   – changing the column selection,

   – changing the column sorting, or by

   – changing the column order.

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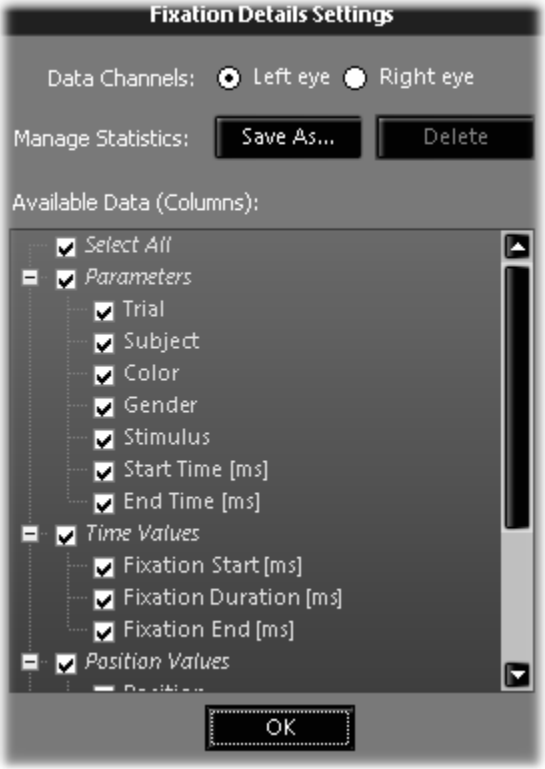
3. Click the **Settings** button to change the columns selection or to copy the modified settings to a new statistic template.



To save the customized **Statistic Templates** press the "Save As..." button in the settings dialog

4. To remove a customized statistic template, open the settings dialog and click the **Delete** button.

5. Optionally, when the settings dialog is closed, you can ...

   – select the **Save Settings for Experiment** menu command or press the [CTRL] + [E] key combination to save the **Statistic Templates** list to the currently opened experiment or

– select the **Save Settings Globally** menu command or press the [CTRL] + [G] key combination, to save the **Statistic Templates** list for use with other experiments. Note that this command will overwrite a previously saved global list.

It is not possible to delete the default statistic templates.

6.11.4 Time Interval

The settings grouped under **Time Window** limit the data to be evaluated while computing the event statistics. The default setting includes all gaze tracking data currently selected for display in the Statistics Selection Trees 135. Both time settings denote a relative time in milliseconds where each trial starts at zero. You can narrow the time window with the following steps:

1. Enter the starting time in the **Start** input. You can enter a number in milliseconds, which is automatically converted to the hh:mm:ss:ms format. You can also enter the time value in the hh:mm:ss:ms format where **hh** denotes a two digit hour value, **mm** denotes minutes, **ss** denotes seconds, and **ms** denote milliseconds.

   All gaze tracking data before this time will be filtered out.

2. Enter the ending time in the **End** input. Note, that the **End** time needs to be larger than the **Start** time.

   All gaze tracking data after this time will be filtered out.

To revert to the default setting, enter "0" in both the Start and End input fields and select a new trial data set in the selection tree.

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6.11.5 Results Grid

The **Result Grid** shows the parameters of the statistics and the computed values. You can customize the results grid view settings and export the current view to a statistics data file (see Export Statistics 140).

To operate the results grid in order to customize the view settings proceed as follows:

1. To resize columns drag a column header's separator.
2. To move columns to another position drag and drop a column header.
3. To sort the results grid click on the desired column header. To reverse the sort order, click the same column header again.
4. To remove columns, click on the Settings button to open the settings dialog
5. To resize all rows hover the mouse over the left border of the results grid. If the mouse cursor changes, drag and drop to indicate the new height.

The results grid view settings are applied temporary for the currently displayed results. The results grid reverts to the former settings, if new results are computed. New results are computed if you change the Selection Tree 135 or when you change the Time Interval 139 settings. To make the results grid settings permanent, proceed as described under Statistics Template 137.

6.11.6 Export Statistics

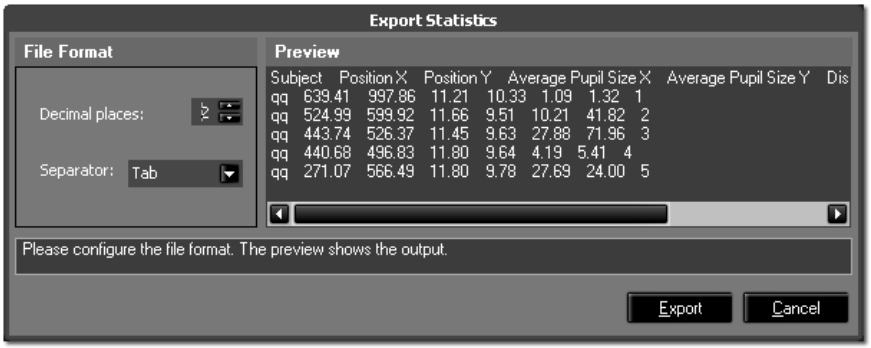
You can export the current display of the Results Grid 140 to an ASCII data file.

Copy to Clipboard

Click on **Copy to Clipboard** button to copy the current shown statistic

into the clipboard for further use in other programs, e.g. MS-Excel.

Export to file


Export Statistics
File Format
Decimal places:
2
Separator:
Tab
Preview
Subject Position X Position Y Average Pupil Size X Average Pupil Size Y Dis
qq 639.41 997.86 11.21 10.33 1.09 1.32 1
qq 524.99 599.92 11.66 9.51 10.21 41.82 2
qq 443.74 526.37 11.45 9.63 27.88 71.96 3
qq 440.68 496.83 11.80 9.64 4.19 5.41 4
qq 271.07 566.49 11.80 9.78 27.69 24.00 5
Please configure the file format. The preview shows the output.
Export
Cancel

1. Click the **Export Current Statistics** button available in the bottom right of the Event Statistics 134 data view.

   The **Export Statistics** dialog opens. The dialog shows a preview of the ASCII data to be exported.

2. Change the exported number precision in the **Decimal places** input.

3. Change the data separator character in the **Separator** drop-down list. While most applications will import ASCII data separated by the tab character, some applications may require another separator character.

4. Click the **Export** button. Select the storage location and enter a file name in the subsequent **Save as...** dialog.

The first line of the exported data file lists the column header names. If you import the ASCII file to another application, these names are then available for identifying the columns.

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6.11.7 Event Statistics - Definitions and Examples

The following tables list details about the default statistic templates that are shipped with the BeGaze 2.3.

Default Statistic Templates

Fixation Details 144	One row per fixation, process all fixations from all selected trials
Saccade Details 144	One row per saccade, process all saccades from all selected trials
Blink Details 146	One row per blink, process all blinks from all selected trials
Event Detailed Statistics 146	One row per trial, process all selected trials
Event Summary Statistics 149	One row for all trials, compute values over all selected trials
AOI Fixations 152	One row for each fixation that hits one AOI, process all selected trials, only on selected AOIs
AOI Detailed Statistics 153	One row for each AOI-trial combination, process all selected trials, only on selected AOIs
AOI Summary Statistics 156	One row per AOI, compute values over all selected trials associated with one AOI
AOI Transition Matrix 167	One row per AOI, number of consecutive fixation transitions inside and between selected AOIs for all selected trials
User Event Statistics 168	One row per recorded user event for all selected trials.

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Notes and Definitions

All processing is constrained to the selected time interval. All fields without a comment represent information extracted directly from the event properties, with average/max/min as the only statistic measurement done when indicated.

The following table comments terms used in the subsequent table texts.

Name	Definition
Dwell time	Dwell time starts at the moment the AOI is fixated and ends at the moment the last fixation on the AOI ends = sum of durations from all fixations and saccades that hit the AOI
Glance Duration	Saccade duration for entering the object + sum of all fixation durations and saccade durations before the eyes begin to leave the AOI = dwell time + duration of saccade entering AOI
Diversion Duration	Sum of saccade durations for entering and leaving the object + sum of all fixation durations and saccade durations before the eyes begin to leave the AOI = glance duration + duration of saccade leaving AOI
Duration Before	Time until AOI is found = start time of first fixation to enter the AOI
Glances	Number of glances to a target (saccades coming from outside) within a certain period (increment the counter each time a fixation hits the AOI, if not hit before)
Saccade latency	Duration between consecutive saccades = average of the time difference between the end of a saccade and the start of the consecutive one

The following color codes denote the parameter origin:

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- parameters
- event properties
- computed values

Fixation Details

This template shows one row per fixation, process all fixations from all selected trials.

Parameter	Dimension unit	Description
Trial		Trial Number
Subject		Subject Code
Stimulus		Stimulus Name
Start Time	[ms]	Trial Start Time, normally zero
End Time	[ms]	Trial End Time
Fixation Start	[ms]	Beginning of a fixation.
Fixation Duration	[ms]	Duration of a fixation.
Fixation End	[ms]	End of a fixation.
Position XY		Geographical position of a fixation .
Average pupil size	[px]	Average size of a pupil.
Dispersion	[px]	Dispersion of a fixation.
Eye L/R		Which eye fixated
Number		Number of the fixation.

Saccade Details

This template shows one row per saccade, process all saccades from all selected trials.

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Parameter	Dimension unit	Description
Trial		Trial Number
Subject		Subject Code
Stimulus		Stimulus Name
Start Time	[ms]	Trial Start Time, normally zero
End Time	[ms]	Trial End Time
Saccade Start	[ms]	Beginning of a saccade.
Saccade Duration	[ms]	Duration of a saccade.
Fixation End	[ms]	End of a saccade.
Start Position XY		Geographical position where the saccade begins.
End Position XY		Geographical position where the saccade ends.
Amplitude	[°]	Max. oscillation from the rest position of a saccade.
Acceleration average	[°/s²]	Average acceleration of a saccade in x.
Acceleration peak	[°/s²]	Peak value of acceleration of gaze during a saccade.
Deceleration peak	[°/s²]	Peak value of deceleration of gaze during a saccade.
Velocity average	[°/s]	Average velocity of gaze during a saccade.
Velocity peak	[°/s]	Peak value of velocity of gaze during a saccade.
Peak velocity at	[%]	Position of the peak velocity within the saccade.
Eye L/R		Which eye does a saccade

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Parameter	Dimension unit	Description
Number		Number of the saccade.

Blink Details

This template shows one row per blink, process all blinks from all selected trials.

Parameter	Dimension unit	Description
Trial		Trial Number
Subject		Subject Code
Stimulus		Stimulus Name
Start Time	[ms]	Trial Start Time, normally zero
End Time	[ms]	Trial End Time
Blink Start	[ms]	Beginning of a blink.
Blink Duration	[ms]	Duration of a blink.
Blink End	[ms]	End of a blink.
Eye L/R		Which eye blinked
Number		Number of the blinks.

Event Detailed Statistics

This template shows one row per trial, process all selected trials.

Parameter	Dimension unit	Description
Trial		Trial Number
Subject		Subject Code
Stimulus		Stimulus Name

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Parameter	Dimension unit	Description
Start Time	[ms]	Trial Start Time, normally zero
End Time	[ms]	Trial End Time
Blink count		Number of blinks in the trial.
Blink frequency	[count/s]	Number of blinks per second.
Blink duration total	[ms]	Sum of duration of all blinks.
Blink duration average	[ms]	Sum of duration of all blinks divided by number of blinks in the trial.
Blink duration maximum	[ms]	Longest blink duration.
Blink duration minimum	[ms]	Shortest blink duration.
Fixation count		Number of fixations in the trial.
Fixation frequency	[count/s]	Number of fixations per second.
Fixation duration total	[ms]	Sum of duration of all fixations.
Fixation duration average	[ms]	Sum of duration of all fixations divided by number of fixations in the trial.
Fixation duration maximum	[ms]	Longest fixation duration.
Fixation duration minimum	[ms]	Shortest fixation duration.
Fixation dispersion total	[px]	Sum of all fixation dispersions on X and Y
Fixation dispersion	[px]	Sum of all fixation

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Parameter	Dimension unit	Description
average		dispersions on X and Y divided by number of fixations in the trial.
Fixation dispersion maximum	[px]	Largest value for the sum of X and Y dispersions of one fixation.
Fixation dispersion minimum	[px]	Smallest value for the sum of X and Y dispersions of one fixation.
Saccade count		Number of saccades in the trial.
Saccade frequency	[count/s]	Number of saccade per second.
Saccade duration total	[ms]	Sum of duration of all saccades..
Saccade duration average	[ms]	Sum of duration of all saccades divided by number of saccades in the trial.
Saccade duration maximum	[ms]	Longest saccade duration.
Saccade duration minimum	[ms]	Shortest saccade duration.
Saccade amplitude total	[°]	Sum of all saccades amplitude.
Saccade amplitude average	[°]	Sum of all saccades amplitude divided by number of saccades in the trial.
Saccade amplitude maximum	[°]	Max. saccade amplitude
Saccade amplitude minimum	[°]	Min. saccade amplitude

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Parameter	Dimension unit	Description
Saccade velocity total	[°/s]	Sum of all saccades velocities.
Saccade velocity average	[°/s]	Sum of all saccades velocities divided by number of saccades in the trial.
Saccade velocity maximum	[°/s]	Max. value of the saccade velocity.
Saccade velocity minimum	[°/s]	Min. value of the saccade velocity.
Saccade latency average	[°/s]	saccade latency = time between the end of a saccade and the start of the next saccade. Saccade latency average = total saccade latency for all saccades / saccade count

Event Summary Statistics

This template shows one row for all trials, compute values over all selected trials.

Parameter	Dimension unit	Description
Start Time	[ms]	Trial Start Time, normally zero
End Time	[ms]	Trial End Time
Blink count		Number of blinks of all selected trials.
Blink frequency	[count/s]	Number of blinks of all selected trials per second divided by the number of selected trials.

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Parameter	Dimension unit	Description
Blink duration total	[ms]	Sum of duration of all blinks of all selected trials.
Blink duration average	[ms]	Sum of duration of all blinks of all selected trials divided by the number of selected trials.
Blink duration maximum	[ms]	Longest blink duration of all selected trials.
Blink duration minimum	[ms]	Shortest blink duration of all selected trials.
Fixation count		Number of fixations of all selected trials.
Fixation frequency	[count/s]	Number of fixations of all selected trials per second divided by the number of selected trials.
Fixation duration total	[ms]	Sum of duration of all fixations of all selected trials.
Fixation duration average	[ms]	Sum of duration of all fixations of all selected trials divided by the number of selected trials.
Fixation duration maximum	[ms]	Longest fixation duration of all selected trials.
Fixation duration minimum	[ms]	Shortest fixation duration of all selected trials.
Fixation dispersion total	[px]	Sum of all fixation dispersions on X and Y of all selected trials.
Fixation dispersion average	[px]	Sum of dispersion of all fixations of all selected trials

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Parameter	Dimension unit	Description
		divided by the number of selected trials.
Fixation dispersion maximum	[px]	Largest value for the sum of X and Y dispersions of fixation of all selected trials.
Fixation dispersion minimum	[px]	Smallest value for the sum of X and Y dispersions of fixation of all selected trials.
Saccade count		Number of saccades of all selected trials.
Saccade frequency	[count/s]	Number of saccades per second of all selected trials divided by the number of selected trials.
Saccade duration total	[ms]	Sum of all saccade duration of all selected trials.
Saccade duration average	[ms]	Sum of all saccade duration of all selected trials divided by the number of selected trials.
Saccade duration maximum	[ms]	Longest saccade duration of all selected trials.
Saccade duration minimum	[ms]	Shortest saccade duration of all selected trials.
Saccade amplitude total	[°]	Sum of all saccades amplitude of all selected trials.
Saccade amplitude average	[°]	Sum of all saccades amplitude of all selected trials divided by the number of saccades in the trial.

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Parameter	Dimension unit	Description
Saccade amplitude maximum	[°]	Max. saccade amplitude of all selected trials.
Saccade amplitude minimum	[°]	Min. saccade amplitude of all selected trials.
Saccade velocity total	[°/s]	Sum of all saccades velocities of all selected trials.
Saccade velocity average	[°/s]	Sum of all saccades velocities of all selected trials divided by the number of saccades in the trial.
Saccade velocity maximum	[°/s]	Max. value of the saccade velocity of all selected trials.
Saccade velocity minimum	[°/s]	Min. value of the saccade velocity of all selected trials.
Saccade latency average	[°/s]	saccade latency = time between the end of a saccade and the start of the next saccade. Saccade latency average = total saccade latency for all saccades / saccade count

AOI Fixations

This template shows one row for each fixation that hits one AOI, process all selected trials, only on selected AOIs.

Parameter	Dimension unit	Description
Subject		Subject Code
Area of Interest		AOI Name

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Parameter	Dimension unit	Description
AOI Order		AOI Order Number
Fixation Start	[ms]	Beginning of a fixation in an AOI.
Fixation Duration	[ms]	Duration of a fixation in an AOI.
Fixation End	[ms]	End of a fixation in an AOI.
Position XY		Geographical position of a fixation inside an AOI.
Average pupil size	[px]	Average size of a pupil inside an AOI.
Dispersion	[px]	Dispersion of a fixation inside an AOI.
Eye L/R		Which eye fixated inside an AOI.
Number		Number of the fixation.

AOI Detailed Statistics

This template shows one row for each AOI-trial combination, process all selected trials, only on selected AOIs.

Parameter	Dimension unit	Description
Trial		Trial Number
Subject		Subject Code
Stimulus		Stimulus Name
Area of Interest		AOI Name
AOI Order		AOI Order Number
AOI Size	[px]	Size of AOI in pixel - the part overlaying the stimulus is

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Parameter	Dimension unit	Description
		taking into consideration, parts outside of the stimuli area are ignored
AOI Coverage	[%]	AOI size in comparison to Stimulus size
Start Time	[ms]	Trial Start Time, normally zero
End Time	[ms]	Trial End Time
Duration before	[ms]	Duration from start of the trial to the first hit of the AOI.
Dwell time	[ms]	Starts at the moment the AOI is fixated and ends at the moment the last fixation on the AOI ends = sum of durations from all fixations and saccades that hit the AOI.
Glance duration	[ms]	Saccade duration for entering the object + sum of all fixation durations and saccade durations before the eyes begin to leave the AOI = dwell time + duration of saccade entering AOI.
Diversion duration	[ms]	Sum of saccade durations for entering and leaving the object + sum of all fixation durations and saccade durations before the eyes begin to leave the AOI = glance duration + duration of saccade leaving AOI.
First fixation duration	[ms]	Duration of the first fixation to

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Parameter	Dimension unit	Description
		hit the AOI.
Glances count		Number of glances to a target (saccades coming from outside) within a certain period (increment the counter each time a fixation hits the AOI, if not hit before). [both eyes]
Fixation count		Number of fixations inside the AOI.
Fixation count		Number of fixations inside the AOI.
Appearance count		Sum of all appearances of one AOI within one trial: – For static AOIs on still images it is always 1 – For dynamic AOIs it is the number of slices where the AOI was visible
Visible time		Sum of AOI duration within one trial – For static AOI it is end time – start time – For dynamic AOI it is the sum of all durations where the AOI was visible within start and end time
Dwell time %	[%]	Value is calculated with: Dwell time (ms) / (end time - start time)
Fixation time (ms)	[ms]	just add the fixations times
Fixation time (%)	[%]	Value is calculated with: Fixation time (ms) / (end time

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Parameter	Dimension unit	Description
		- start time)

The Duration before cell contains "-" if the corresponding AOI is not hit by any fixation during the selected period of time.

AOI Summary Statistics

This template shows one row per AOI, compute values over all selected trials associated with one AOI.

Parameter	Dimension unit	Description
Stimulus		Stimulus Name
Area of Interest		AOI Name
AOI Group		AOI Group Name
AOI Scope		Scope of AOI - local or global
AOI Order		AOI Order Number
AOI Size	[px]	Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored
AOI Coverage	[%]	AOI size in comparison to Stimulus size
Start Time	[ms]	Trial Start Time, normally zero
End Time	[ms]	Trial End Time
Duration	[ms]	Sum of duration before of all subjects.

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Parameter	Dimension unit	Description
Stimulus		Stimulus Name
Area of Interest		AOI Name
AOI Group		AOI Group Name
AOI Scope		Scope of AOI - local or global
AOI Order		AOI Order Number
AOI Size	[px]	Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored
before total		
Duration before average	[ms]	Sum of duration before of all subjects divided by number of the subjects.
Duration before maximum	[ms]	Max. duration before of all subjects.
Duration before minimum	[ms]	Min. duration before of all subjects.
Dwell time total	[ms]	Sum of dwell time of all subjects.
Dwell time	[ms]	Sum of dwell time of all subjects divided by number of the subjects.

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Parameter	Dimension unit	Description
Stimulus		Stimulus Name
Area of Interest		AOI Name
AOI Group		AOI Group Name
AOI Scope		Scope of AOI - local or global
AOI Order		AOI Order Number
AOI Size	[px]	Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored
average		
Dwell time maxi-mum	[ms]	Max. dwell time of all subjects.
Dwell time minimum	[ms]	Min. dwell time of all subjects.
Glance duration total	[ms]	Sum of glance duration of all subjects.
Glance duration average	[ms]	Sum of glance duration of all subjects divided by number of the subjects.
Glance duration maximu	[ms]	Max. glance duration of all subjects.

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Parameter	Dimension unit	Description
Stimulus		Stimulus Name
Area of Interest		AOI Name
AOI Group		AOI Group Name
AOI Scope		Scope of AOI - local or global
AOI Order		AOI Order Number
AOI Size	[px]	Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored
m		
Glance duration minimum	[ms]	Min. glance duration of all subjects.
Diversion duration total	[ms]	Sum of diversion duration of all subjects.
Diversion duration average	[ms]	Sum of diversion duration of all subjects divided by number of the subjects.
Diversion duration maximum	[ms]	Max. diversion duration of all subjects.

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Parameter	Dimension unit	Description
Stimulus		Stimulus Name
Area of Interest		AOI Name
AOI Group		AOI Group Name
AOI Scope		Scope of AOI - local or global
AOI Order		AOI Order Number
AOI Size	[px]	Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored
Diversion duration minimum	[ms]	Min. diversion duration of all subjects.
First fixation duration total	[ms]	Sum of first fixation duration of all subjects.
First fixation duration average	[ms]	Sum of first fixation duration of all subjects by number of the subjects.
First fixation duration maximum	[ms]	Max. first fixation duration of all subjects.
First	[ms]	Min. first fixation duration of all subjects.

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Parameter	Dimension unit	Description
Stimulus		Stimulus Name
Area of Interest		AOI Name
AOI Group		AOI Group Name
AOI Scope		Scope of AOI - local or global
AOI Order		AOI Order Number
AOI Size	[px]	Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored
fixation duration minimum		
Glances count total		Sum of first glances count of all subjects.
Glances count average		Sum of first glances count of all subjects by number of the subjects.
Glances count maximum		Max. first glances count of all subjects.
Glances count minimum		Min. first glances count of all subjects.

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Parameter	Dimension unit	Description
Stimulus		Stimulus Name
Area of Interest		AOI Name
AOI Group		AOI Group Name
AOI Scope		Scope of AOI - local or global
AOI Order		AOI Order Number
AOI Size	[px]	Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored
Fixation count total		Sum of first fixation count of all subjects.
Fixation count average		Sum of first fixation count of all subjects by number of the subjects.
Fixation count maximum		Max. first fixation count of all subjects.
Fixation count minimum		Min. first fixation count of all subjects.
Appearance count total		Sum of all appearances of one AOI within one trial of all subjects.

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Parameter	Dimension unit	Description
Stimulus		Stimulus Name
Area of Interest		AOI Name
AOI Group		AOI Group Name
AOI Scope		Scope of AOI - local or global
AOI Order		AOI Order Number
AOI Size	[px]	Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored
Appearance count average		Sum of all appearances of one AOI within one trial of all subjects by number of the subjects.
Appearance count maximum		Max. sum of all appearances of one AOI within one trial of all subjects.
Appearance count minimum		Min. sum of all appearances of one AOI within one trial of all subjects.
Visible time total		Sum of AOI duration within one trial of all subjects.
Visible time		Sum of AOI duration within one trial of all subjects by number of the subjects.

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Parameter	Dimension unit	Description
Stimulus		Stimulus Name
Area of Interest		AOI Name
AOI Group		AOI Group Name
AOI Scope		Scope of AOI - local or global
AOI Order		AOI Order Number
AOI Size	[px]	Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored
average		
Visible time maximum		Max. sum of AOI duration within one trial of all subjects.
Visible time minimum		Min. sum of AOI duration within one trial of all subjects.
Dwell time total	[%]	Dwell time percentage of all subjects.
Dwell time average	[%]	Dwell time percentage of all subjects by number of the subjects.
Dwell time maximu	[%]	Max dwell time percentage of all subjects.

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Parameter	Dimension unit	Description
Stimulus		Stimulus Name
Area of Interest		AOI Name
AOI Group		AOI Group Name
AOI Scope		Scope of AOI - local or global
AOI Order		AOI Order Number
AOI Size	[px]	Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored
m		
Dwell time minimum	[%]	Min. dwell time percentage of all subjects.
Fixation time total	[ms]	Added fixations times of all subjects.
Fixation time average	[ms]	Added fixations times of all subjects by number of the subjects.
Fixation time maximum	[ms]	Max. added fixations times of all subjects.
Fixation time minimu	[ms]	Min. added fixations times of all subjects.

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Parameter	Dimension unit	Description
Stimulus		Stimulus Name
Area of Interest		AOI Name
AOI Group		AOI Group Name
AOI Scope		Scope of AOI - local or global
AOI Order		AOI Order Number
AOI Size	[px]	Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored
m		
Fixation time total	[%]	Fixation times percentage of all subjects.
Fixation time average	[%]	Fixation times percentage of all subjects by number of the subjects.
Fixation time maximum	[%]	Max fixation times percentage of all subjects.
Fixation time minimum	[%]	Min. fixation times percentage of all subjects.
Subject Hit Count		Number of subjects that looked into the AOI

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Parameter	Dimension unit	Description
Stimulus		Stimulus Name
Area of Interest		AOI Name
AOI Group		AOI Group Name
AOI Scope		Scope of AOI - local or global
AOI Order		AOI Order Number
AOI Size	[px]	Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored
Subject Hit Count	[%]	Number of subjects that looking into the AOI in comparison to all selected subjects

The duration before values are computed only on valid trials which associated with a stimulus (the ones that contain at least one fixation inside the corresponding AOI during the selected period of time). The other values are computed on all selected trials associated with the stimulus.

Transition Matrix (Stacking Order, All)

This template shows one row per AOI, number of consecutive fixation transitions inside and between selected AOIs for all selected trials.

Stacking Order: In case of overlapping AOI the most top AOI is taken into consideration

All: All AOI are taken into consideration, even though when they are overlapping

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Parameter	Dimension unit	Description
Stimulus		Stimulus Name
from \ to (count)		Column lists all AOI names
Area of Interest		One column for each AOI, all columns for a matrix
[Matrix cells]		Number of transitions from AOI to AOI

User Event Statistics

This template shows one row per recorded user event for all selected trials.

Parameter	Dimension unit	Description
Trial		Trial Number
Subject		Subject Code
Stimulus		Stimulus Name
Start Time	[ms]	Trial Start Time, normally zero
Event Action		Type of user event
Event		Event parameter
Event 2		Event additional parameter

6.11.8 Reading Statistics - Definitions and Examples

The following tables list details about the reading statistic templates that are shipped with the BeGaze 2.3 when the reading package is licensed.

Default Statistic Templates

Fixation Duration 170

Saccadic Amplitude 171

AOI Statistics 172

Landing Position AOI 175

Pause Duration 175

First Pass Regression Scanpath 176

Return Sweep 177

Inner-AOI Regressions 179

Between AOI Regressions 180

AOI Hits per Minute 182

Notes and Definitions

All processing is constrained to the selected time interval. All fields without a comment represent information extracted directly from the event properties, with average/max/min as the only statistic measurement done when indicated.

Reading AOI's are generated for

- Paragraphs
- Words
- Sentences
- Characters

Reading AOIs are automatically generated and cannot be self defined but modified in size and position in the AOI editor.

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Please note, that character AOIs are disabled by default. When character AOIs are enabled, please be aware that this creates a huge amount of additional data (several thousands of additional AOIs) and will slow down the calculation process for statistics and other computations. It is strongly recommended to leave the character AOIs disabled until they are really needed.

The following color codes denote the parameter origin:

- parameters
- event properties
- computed values

Fixation Duration

This template shows one row per fixation, process all fixations from all selected trials.

Parameter	Dimension unit	Description
Trial		Trial Number
Subject		Subject Code
Stimulus		Stimulus Name
Fixation Start	[ms]	Beginning of a fixation
Fixation Duration	[ms]	Duration of a fixation *Note*: A longer fixation duration is often associated with a deeper and more effortful cognitive processing. Just and Carpenter (1980) formulated this relation in the influential Strong Eye-Mind Hypothesis, which claims that there is no appreciable temporal lag between what is fixated and what is processed. In reading research, words that are less frequent, and would therefore require a longer lexical activation

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		process, generally get longer fixation durations (Rayner 1998). More complicated texts give rise to longer average fixation durations, ranging from around 200 ms in light fiction to around 260 ms for physics and biology texts (Rayner and Pollatsek, 1989). More complicated grammatical structures give rise to longer fixation durations (Rayner 1978, 1982). Note that fixation duration is an idiosyncratic measure.
Fixation End	[ms]	End of a fixation
Fixation Position XY		Geographical position of a fixation
Word		Fixated word
Reading AOI number		Fixated AOI number
Reading direction		Reading direction (Left to Right or Right to Left)
Eye		Which eye fixated

Saccadic Amplitude

This template shows one row per saccade, process all saccades from all selected trials.

Parameter	**Dimension unit**	**Description**
Trial		Trial Number
Subject		Subject Code
Stimulus		Stimulus Name
Saccade start	[ms]	Beginning of a saccade
Saccade duration	[ms]	Duration of a saccade
Saccade end	[ms]	End of a saccade

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Saccade startPosition XY		Geographical position where the saccade begins
Saccade endPosition XY		Geographical position where the saccade ends
Saccade amplitude	[px]	Max. oscillation from the rest position of a saccade *Note*: The same effect on saccadic amplitude (and fixation duration) can be found when subject read texts of varying difficulty (Rayner and Pollatsek 1989). Beginning, poor and dyslectic readers have shorter saccadic amplitudes. In oral reading, average saccadic amplitude falls to around 6 letters (1:5), while during music reading and typing, saccades are a mere 1 on average. For subjects reading musical scores, Kinsler and Carpenter (1995) found that the mean saccadic amplitude increased as the tempo of the performance increased.
Start word		Fixated word before saccade started
Start reading AOI number		Fixated AOI before saccade started
End word		Fixated word after saccade ended
End reading AOI number		Fixated AOI after saccade ended
Reading direction		Reading direction (Left to Right or Right to Left)
Eye		Which eye does a saccade

AOI Statistics

This template shows one row for each AOI-trial combination, process all selected trials, only on selected AOIs.

Parameter	Dimension	Description

	unit	
Trial		Trial Number
Subject		Subject Code
Stimulus		Stimulus Name
Area of Interest		AOI name
Reading AOI Type		AOI type
Reading AOI number		AOI number
Fixation count		Number of fixations inside an AOI
Progressive fixations		Number of progressive fixations (preceded by progressive saccades)
Regressions into AOI		Number of regressions into an AOI
Regressions out of AOI		Number of regressions out of an AOI *Note*: While regressions inside words are thought to reflect lexical activation processes (understanding the word), regressions between word reflect sentence integration processes (understanding how several words relate), see chapters 4 and 5 in Underwood (1998).
Regressive fixations		Number of regressive fixations (preceded by regressive saccades)
Single fixation duration	[ms]	The fixation duration of the fixation on a word, for AOIs in which only one fixation has been made *Note*: Single fixation duration is one of the measures for studying lexical activation; known as early processes.
First fixation duration	[ms]	The duration of the first fixation in an AOI (if any) *Note*: Generally, Rayner and Pollatsek (1989) argue that very fast cognitive operation (like lexical activation and recognition) can be measured with first fixation duration, while slower

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		cognitive processes affect gaze duration (=dwell time). The word properties that affect first fixation duration include word frequency, morphological complexity, metaphorical status, orthographic properties, the degree of polysemy and other linguistic computations.
First pass duration	[ms]	Sum of fixation durations from the first entry into an AOI until the eye leaves it in any direction *Note*: First pass gaze duration is considered a measure of linguistic processes slower than lexical activation. Rayner (1998), reviewing reading research using the fixation based gaze duration measure, concludes that gaze duration is indicative both of word frequency and of comprehension processes integrating several words. Gaze duration on a word thus contrasts to first fixation duration, the other major reading measure, which is used as an index on word frequency. "Gaze duration" is a reading research term. It is defined exactly as dwell time.
First return to AOI	[ms]	Time of occurrence for the first re-entry into an AOI
Second pass duration	[ms]	Sum of fixation durations from the second entry into an AOI until the eye leaves it in any direction *Note*: Second pass gaze duration on a word is assumed to reflect late effects (word integration processes).
Ratio saccade / next fixation	[%]	Saccade time divided by next fixation time
Ratio saccade / prev fixation	[%]	Saccade time divided by previous fixation time
Is first skip		AOIs (words) that are not fixated during first pass reading (although they may be fixated during later regressions) *Note*: Readers skip over high predictable words more frequently than low predictable words (Rayner & Well 1996).

Is total skip		AOIs (words) that are never fixated
Eye		Which eye fixated inside an AOI

Landing Position AOI

This template shows one row for each AOI-trial combination, process all selected trials, only on selected AOIs.

Parameter	Dimension unit	Description
Trial		Trial Number
Subject		Subject Code
Stimulus		Stimulus Name
Area of Interest		AOI name
Reading AOI Type		AOI type
Reading AOI number		AOI number
Reading AOI landing position	[%]	Quotient between AOI length and fixation position inside the AOI
Eye		Which eye fixated inside an AOI

Pause Duration

This template shows one row for each AOI-trial combination, process all selected trials, only on selected AOIs.

Parameter	Dimension unit	Description
Trial		Trial Number

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Subject		Subject Code
Stimulus		Stimulus Name
Fixation Start	[ms]	Beginning of a fixation
Fixation Duration	[ms]	Duration of a fixation
Fixation End	[ms]	End of a fixation
Fixation Position XY		Geographical position of a fixation
Word		Fixated word
Reading AOI number		AOI number
Fixation pause	[ms]	Fixation duration + the duration of the subsequent saccade
Eye		Which eye fixated

First Pass Regression Scanpath

Parameter	Dimension unit	Description
Trial		Trial Number
Subject		Subject Code
Stimulus		Stimulus Name
Event type		Type of user event
Start	[ms]	First Pass Regression start time
Duration	[ms]	First Pass Regression duration *Note*: The duration of the regression scanpath is a measure of sentence integration processes.
End	[ms]	First Pass Regression end time

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StartPosition XY		Position when first pass regression started
EndPosition XY		Position when first pass regression ended
Start word		Fixated word when first pass regression started
Start reading AOI number		AOI number when first pass regression started
End word		Fixated word when first pass regression ended
End reading AOI number		AOI number when first pass regression ended
Number		Number of events durring first pass regression
Eye		Which eye fixated

Return Sweep

Parameter	Dimension unit	Description
Trial		Trial Number
Subject		Subject Code
Stimulus		Stimulus Name
Saccade return sweep start	[ms]	Return sweep start time
Saccade return sweep duration	[ms]	Return sweep duration
Saccade return sweep end	[ms]	Return sweep end time
Saccade return sweep startPosition XY		Start position for return sweep
Saccade return sweep endPosition XY		End position for return sweep

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Saccade correction start	[ms]	Correction saccade start time
Saccade correction duration	[ms]	Correction saccade duration
Saccade correction end	[ms]	Correction saccade end time
Saccade correction startPosition XY		Start position for correction saccade
Saccade correction endPosition XY		End position for correction saccade
Saccade return sweep start word		Fixated word before return sweep
Saccade return sweep start reading AOI number		Fixated AOI number before return sweep
Saccade return sweep end word		Fixated word after return sweep
Saccade return sweep end reading AOI number		Fixated AOI number after return sweep
Saccade correction end word		Fixated word after correction saccade
Saccade correction end reading AOI number		Fixated AOI after correction saccade
Fixation intermediate start	[ms]	Intermediate fixation start time
Fixation intermediate duration	[ms]	Intermediate fixation duration

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Fixation intermediate end	[ms]	Intermediate fixation end time
Fixation intermediatePosition XY		Position for intermediate fixation
Fixation intermediate word		Fixated word in intermediate fixation
Fixation intermediate reading AOI number		AOI number in intermediate fixation

Inner-AOI Regressions

Parameter	Dimension unit	Description
Trial		Trial Number
Subject		Subject Code
Stimulus		Stimulus Name
Prev. Fixation start	[ms]	Previous fixation start time
Prev. Fixation duration	[ms]	Previous fixation duration
Prev. Fixation end	[ms]	Previous fixation end time
Prev. FixationPosition XY		Previous fixation position
Next Fixation start	[ms]	Next fixation start time
Next Fixation duration	[ms]	Next fixation duration

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Next Fixation end	[ms]	Next fixation end time
Next FixationPosition XY		Next fixation position
Regressive Saccade start	[ms]	Intermediate regressive saccade start time
Regressive Saccade duration	[ms]	Intermediate regressive saccade duration
Regressive Saccade end	[ms]	Intermediate regressive saccade end time
Regressive Saccade startPosition XY		Intermediate regressive saccade start position
Regressive Saccade endPosition XY		Intermediate regressive saccade end position
Area of Interest		AOI name
Reading AOI number		AOI number
Eye		Which eye fixated inside an AOI

Between AOI Regressions

Parameter	Dimension unit	Description
Trial		Trial Number
Subject		Subject Code
Stimulus		Stimulus Name
Prev. Fixation start	[ms]	Previous fixation start time
Prev. Fixation	[ms]	Previous fixation duration

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duration		
Prev. Fixation end	[ms]	Previous fixation end time
Prev. FixationPosition XY		Previous fixation position
Next Fixation start	[ms]	Next fixation start time
Next Fixation duration	[ms]	Next fixation duration
Next Fixation end	[ms]	Next fixation end time
Next FixationPosition XY		Next fixation position
Regressive Saccade start	[ms]	Intermediate regressive saccade start time
Regressive Saccade duration	[ms]	Intermediate regressive saccade duration
Regressive Saccade end	[ms]	Intermediate regressive saccade end time
Regressive Saccade startPosition XY		Intermediate regressive saccade start position
Regressive Saccade endPosition XY		Intermediate regressive saccade end position
Area of Interest start		Previous AOI name
Reading AOI number start		Previous AOI number
Area of Interest end		Next AOI name
Reading AOI number end		Next AOI number
Eye		Which eye fixated inside an AOI

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AOI Hits per Minute

This template shows one row per selected trials.

Parameter	Dimension unit	Description
Trial		Trial Number
Subject		Subject Code
Stimulus		Stimulus Name
Reading AOI Hits character		Character AOI hits per minute
Reading AOI Hits word		Word AOI hits per minute *Note*: This is the word-per-minute (WPM) measure, a classical measure for reading speed. In the eye-tracking version, WPM can be made a continuous measure that varies along the text.
Reading AOI Hits sentence		Sentence AOI hits per minute
Reading AOI Hits paragraph		Paragraph AOI hits per minute
Eye		Which eye fixated inside an AOI

6.11.9 Reading Statistics - References

Berséus, P. (2002). Eye movement in prima vista singing and vocal text reading.
Unpublished master's thesis, Lund University.
Clifton, C., Staub, A., & Rayner, K. (2006). Eye movements: A window on
mind and brain. In R. P. G. van Gompel, M. H. Fischer, W. S.Murray, & R. L. Hill (Eds.), (chap. Eye movements in reading words and sentences.).
Elsevier, Oxford.

Diepen P.M.J. van, M., W., & G. d'Ydewalle. (1998). Eye guidance in reading,
driving, and scene perception. In G. Underwood (Ed.), (chap. Functional division of the visual field: moving masks and moving windows.). Oxford: Elsevier.
Holmqvist, K., Holsanova, J., Barthelson, M., & Lundqvist, D. (2003). Reading
or scanning? a study of newspaper and net paper reading. In The mind's eye: Cognitive and applied aspects of eye movement research (p. 657-670).
Elsevier Science Ltd.
Holmqvist, K., & Wartenberg, C. (2005). The role of local design factors for newspaper reading behaviour – an eye-tracking perspective (Tech. Rep.
No. 127). Lund University Cognitive Studies.
Holsanova, J., Holmberg, N., & Holmqvist, K. (2008). Reading information
graphics: The role of spatial contiguity and dual attentional guidance. Appl. Cognit. Psychol..
Holsanova, J., Rahm, H., & Holmqvist, K. (2006). Entry points and reading
paths on newspaper spreads: comparing a semiotic analysis with eyetracking
measurements. Visual Communication, 5 (1), 65-93. Available from http://vcj.sagepub.com/cgi/content/abstract/5/1/65
Huey, E. B. (1898). Preliminary experiments in the physiology and psychology
of reading. American Journal of Psychology, 9 , 575-586.
Hyrskykari, A. (2006). Utilizing eye movements: Overcoming inaccuracy while tracking the focus of attention during reading. Computers
in Human Behavior, 22 (4), 657 - 671. Available from http://www.sciencedirect.com/science/article/B6VDC-4J72YW1-2/2/8ba5466cc55abcaaf639bc20d15314c3
(Attention aware systems - Special issue: Attention aware systems)
Inhoff, A. W., & Radach, R. (1998). Eye guidance in reading, driving and scene
perception. In G. Underwood (Ed.), (p. 29-53). New York: Elsevier.
Johansson, R., Holmqvist, K., Mossberg, F., & Lindgren, M. (2009). Music you
prefer to study to impairs reading comprehension.

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Johansson, R., Johansson, V., Wengelin, Å., & Holmqvist, K. (2008). Reading during writing: Four groups of writers. (Working Papers No. 53). Department of Linguistics, Lund University.

Johansson, R., Johansson, V., Wengelin, Å., & Holmqvist, K. (in press). Looking at the keyboard or the monitor: Relationship with text production processes. Reading and Writing.

Kollmorgen, S., & Holmqvist, K. (2009). Automatically detecting reading in eye tracking data (LUCS No. 144). Department of Cognitive Science.

Krischer, C., & Zangemeister, W. (2007). Scanpaths in reading and picture viewing: Computer-assisted optimization of display conditions. Computers in Biology and Medicine, 37 (7), 947 - 956. Available from http://www.sciencedirect.com/science/article/B6T5N-4NB2SN9-2/2/73537cff18bfb34e14d8e45538be90a2 (Vision and Movement in Man and Machines)

Liversedge, S., Paterson, K., & M.J., P. (1998). Eye guidance in reading, driving, and scene perception. In G. Underwood (Ed.), (chap. Eye movements and measures of reading time.). Oxford: Elsevier.

Liversedge, S., White, S., Findlay, J., & Rayner, K. (2006). Binocular coordination of eye movements during reading. Vision research, 46 (15), 2363–2374.

McConkie, G. W., Kerr, P. W., Reddix, M. D., & Zola, D. (1988). Eye movement control during reading: I the location of initial eye fixations on words. Vision Research, 28 , 1107-1118.

McConkie, G. W., Kerr, P. W., Reddix, M. D., Zola, D., & Jacobs, A. M. (1989). Eye movement control during reading: Ii frequency of refixating a word. Perception and Psychophysics, 46 , 245-253.

Rayner, K. (1998). Eye movements in reading and information processing: 20 years of research. Psychological Bulletin, 124 (3), 372–422.

Rayner, K., Li, X., Williams, C., Cave, K., & Well, A. (2007). Eye movements

during information processing tasks: Individual differences and cultural effects. Vision Research, 47 (21), 2714–2726.
Rayner, K., & Pollatsek, A. (1989a). The psychology of reading. Englewood
Cliffs, NJ: Prentice Hall.
Rayner, K., & Pollatsek, A. (1989b). The psychology of reading.
Renshaw, J. A., Finlay, J. E., Tyfa, D., & Ward, R. D. (2004). Regressions
re-visited: a new definition for the visual display paradigm. In Chi '04: Chi '04 extended abstracts on human factors in computing systems (pp. 1437–1440). New York, NY, USA: ACM.
Sullivan, B., Jovancevic, J., Hayhoe, M., & Sterns, G. (2005). Use of gaze in natural tasks in stargardt's disease: A preferred retinal region. International Congress Series, 1282 , 608 - 612. Available from http://www.sciencedirect.com/science/article/B7581-4H8DPNP-4W/2/e4819ada0573583ad3ed7a0277723bbf
(Vision 2005 - Proceedings of the International Congress held between 4 and 7 April 2005 in London, UK)
Takeda, Y., Sugai, M., & Yagi, A. (2001). Eye fixation related potentials in a proof reading task. International Journal
of Psychophysiology, 40 (3), 181 - 186. Available from http://www.sciencedirect.com/science/article/B6T3M-42DP0HD-2/2/586b0c37ba4efcd04248bea842b36f2c
Underwood, G. (1998). Eye guidance in reading, driving, and scene perception.
Elsevier.

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Event Detection

Chapter

7 Event Detection

7.1 Built-In Event Detector

BeGaze 2.3 has a built-in saccade, fixation and blink detector. A saccade is defined as a rapid change in gaze location, and a fixation is regarded as being bordered by two saccades. A blink can be considered a special case of a fixation, where eye data is not present.

In general, there are two approaches for the built-in detector: Either it can first look for fixations and the other events are derived from them, or it can first look for saccades, followed by the computation of the other events.

Which event the detector searches first, we call *primary event*. If the primary event is *fixation*, the detector uses a *dispersion* based algorithm. If the primary event is saccade, a *velocity* based algorithm is used.

For low speed eye tracking data (< 200 Hz), choosing fixations as primary event achieves the best results, whereas primary looking for saccades is sensible for high speed eye tracking data.

Depending on the sample rate the built-in detector selects the detection method:

sample rate	**detection method**	**primary event**	**algorithm based on**
all data rates	low speed event detection 191	fixation	dispersion
200 Hz and above	high speed event detection 193	saccade	velocity

Please note, that none of the algorithms are currently well suited to detect fixations on moving targets in videos where the eyes are following with a smooth pursuit. This issue is currently addressed in ongoing research work.

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7.2 Adjust Event Detection

In the **Adjust Event Detection** dialog, you can change the event detection parameters as well as the stimulus geometry for one or more trials.

1. In the File menu 218 select the **Adjust Event Detection** command.

   The **Adjust Event Detection** dialog opens.

2. In the **Fixation detection parameters** section of the dialog, you can change settings for low speed event detection or for high speed event detection. Which type of settings are available, depends on the gaze tracking device used.

3. In the **Geometry** section of the dialog, you can adapt resolution and dimension of the presented stimuli.

4. Confirm you settings with **OK**.

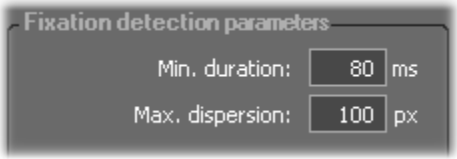
When creating an experiment, you can adjust these parameters in the Event Detection 35 tab of the **Create Experiment** wizard.

Exclude first fixation

The first fixation can be deleted from all datasets in the experiment if required.

Low Speed Event Detection Settings

For Low Speed Event Detection 191 the following parameters are displayed and can be changed:



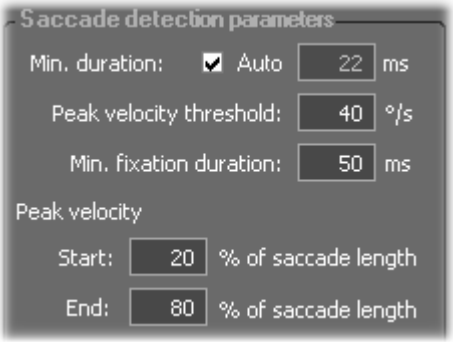
Min. duration: minimum fixation duration in [ms]

Max. dispersion: maximum dispersion value. The unit depends on the experiment type 229:

	Unit
standard data	pixels
data with head tracking	degrees

High Speed Event Detection Settings

For High Speed Event Detection 193 the following parameters are displayed and can be changed:



Min. duration: minimum saccade duration in [ms]. If the Auto option is checked, the minimum duration varies and is automatically set dependent on the peak threshold.

Peak velocity threshold: peak velocity threshold in [°/s]

Min. fixation duration: minimum fixation duration in [ms]. All fixations below the threshold are rejected.

Peak velocity window: The single peak value has to lie in this window. Start and end is given in % of the saccade length.

For more information see Built-In Event Detector 187.

If you click on **Adjust**, the saccades, fixations and blinks will be

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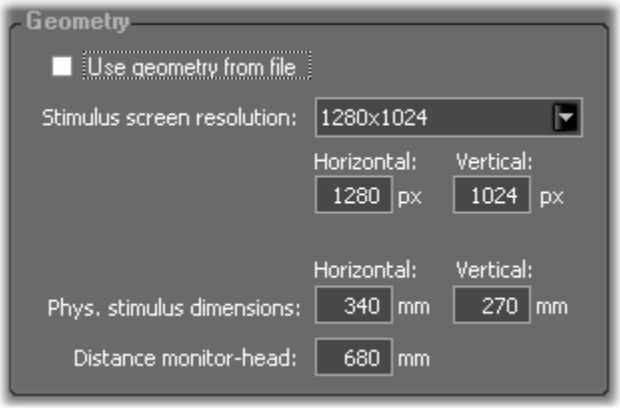
recalculated for all the trials in the experiment, using the displayed detection parameters. The changes are persistent for each trial.

Geometry Settings



Activate the **Use geometry from file** option to read in the screen resolution and physical stimulus dimension settings from the gaze tracking data file. Activating this option immediately reads in the settings from the gaze tracking data file and disables the respective controls.

Deactivate the **Use geometry from file** option if you want to overwrite these settings manually. Deactivating this option enables the following settings:

Stimulus screen resolution: Enter the horizontal and vertical resolution (in pixels) of the monitor which originally displayed all visual stimuli. A list of typical screen resolutions is offered in a drop-down list for selection. To enter a screen resolution not available in the list, select the **user defined** entry or simply enter the desired resolution in the respective text input controls. Note, that all visual stimuli attributed with the **Fit to Screen** option will be recalculated and scaled to this resolution.

Phys. stimulus dimensions: Enter the horizontal and vertical display dimensions in millimeters. Note, that a typical CRT or LCD computer monitor has a display resolution between 72 dpi and 120 dpi with the same horizontal and vertical dpi resolution. Example: a 96 dpi LCD

monitor displaying 1280 horizontal pixels should have a width of 338 mm (1280 px / 96 dpi * 25,4 mm per inch). Note also that other displays such as a video beamer emitting camcorder material typically use a different dpi resolution for horizontal and vertical display.

Distance monitor-head: If you change the **Phys. stimulus dimensions** settings, you need to adapt the approximate distance between the displaying monitor and the subjects head accordingly. Note that during calibration the individual relation between the gaze tracking system and the subject is established. The calibration outcome is not changed nor invalidated with this setting.

Overwriting and changing the geometry settings requires BeGaze 2.3 to re-calculate the gaze tracking data in order to adapt to the new settings. For longer experiments, the recalculation may require some time with the progress indicated by a status dialog.

7.3 Low Speed Event Detection

In the Low Speed Event Detection method, Fixation is selected as primary event. The Built-In Detector 187 will first search for fixation events, using a dispersion based algorithm, after which saccade events are computed and derived from the primary fixation events.

Blink Detection

A blink can be regarded as a special case of a fixation, where the horizontal and vertical gaze position equals 0. If this is the case, we create a blink event. However, the duration of the blink event is expanded in order to include the transition period between valid gaze data and the blink.

Fixation Detection

The Minimum Fixation Duration defines the minimum time window in which the gaze data is analyzed. Fixations smaller than the time window will not be caught.

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The algorithm identifies fixations as groups of consecutive points within a particular dispersion, or maximum separation. It uses a moving window that spans consecutive data points checking for potential fixations. The moving window begins at the start of the protocol and initially spans a minimum number of points, determined by the given Minimum Fixation Duration and sampling frequency.

The algorithm then checks the dispersion of the points in the window by summing the differences between the points' maximum and minimum x and y values; in other words, dispersion D = [max(x) - min(x)] + [max(y) - min(y)]. If the dispersion is above the Maximum Dispersion Value, the window does not represent a fixation, and the window moves one point to the right. If the dispersion is below the Maximum Dispersion Value, the window represents a fixation. In this case, the window is expanded to the right until the window's dispersion is above threshold. The final window is registered as a fixation at the centroid of the window points with the given onset time and duration.

Saccade Detection

At the end a saccade event is created between the newly and the previously created blink or fixation.

Parameters

The parameters can be changed in the Adjust Event Detection 188 dialog.

Min. duration: minimum fixation duration in [ms]

Max. dispersion: maximum dispersion value. The unit depends on the experiment type 229:

	Unit
standard data	pixels

	Unit
data with head tracking	degrees

Further Reading:

Dario D. Salvucci & Joseph H. Goldberg:

Identifying Fixations and Saccades in Eye-Tracking Protocols

In: Proceedings of the Eye Tracking Research and Applications Symposium (pp. 71-78). New York, 2000

7.4 High Speed Event Detection

In the High Speed Event Detection method, Saccade is selected as primary event. The Built-In Detector 187 will first search for saccade events, using a velocity based algorithm. Blinks and fixations are computed and derived from the primary saccade events.

Saccade Detection

From the gaze stream all velocities are calculated. From all velocities the peaks are detected. A peak is defined as the peak value of velocities above the Peak Threshold [º/s]. The peak could indicate a saccade, but as we are not sure, yet, we call it saccade-like event. To detect the start of the saccade-like event, we search for the first velocity to the left which is lower than the fixation velocity threshold. To detect the end of the saccade-like event, we search for the first velocity to the right which is lower than the fixation velocity threshold. The fixation velocity threshold is an internal value calculated from the first peak less velocities of the velocity stream. We assume the saccade-like event a real saccade, if

a) the distance between start and end exceeds the Minimum Saccade Duration [ms] and

b) the single peak value lies in the range of 20% to 80% of the distance between start and end

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Blink Detection

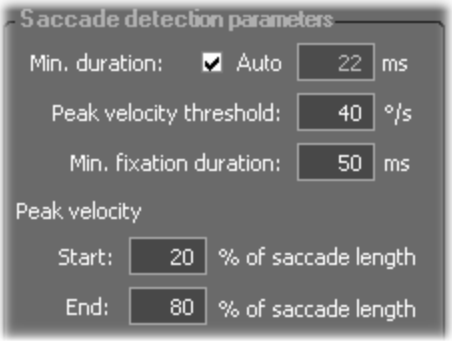
However, the saccade we have found could still be an artifact as a result of a start or end of a blink. If so, we discard the saccade event and assign the artificial saccade to a blink. To determine, if this is the case we evaluate the pupil diameter during the saccade period. If the speed of the pupil diameter change exceeds an internal threshold value, the saccade is assumed artificial and part of the blink.

Fixation Detection

Finally, we create a fixation event between the newly and the previously created blink or saccade.

Parameters

The parameters can be changed in the Adjust Event Detection 188 dialog.



Min. duration: minimum saccade duration in [ms]. If the Auto option is clicked, the minimum duration varies and is automatically set dependent on the peak threshold.

Peak threshold: peak velocity threshold in [°/s]

Min. fixation duration: minimum fixation duration in [ms]. All fixations below the threshold are rejected. The default value is 50 ms.

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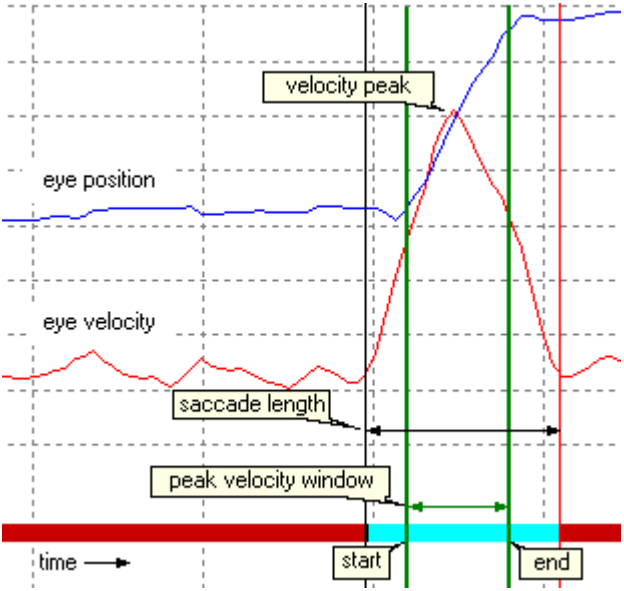
Peak Velocity Window

The velocity curve must resemble a certain pattern to be regarded as the velocity of a saccade. In a typical saccade the velocity of the eye movement increases, reaches a peak and decreases. At first, the detector assumes this kind of movement to be a saccade. The time between start and end of movement is called saccade length. Then the detector searches, if the velocity peak lies within a certain time window inside of the saccade. If the peak lies outside, the assumed saccade is discarded. The start and end of the time window is given in % of the saccade length.

Default values:

Start: 20% of saccade length

End: 80% of saccade length



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Export and Conversions

Chapter

8 Export and Conversions

8.1 Overview

BeGaze 2.3 allows events export 197 and raw data export 204.
Furthermore, you can record the replay of the scan path, attention map or key performance indicators to an AVI file (see Video Export 210).

8.2 Export Events

8.2.1 Export Events

In case you want to perform further evaluation with third party software, it is possible to export the events to a custom delimited table in ASCII text format.

If you click on the toolbar item or go to the Export menu and select Export event data to file, a window will be displayed, containing the following tabs:

- General
- Preview

Trial selection

Select the Trials from the Experiment, whose Events should be exported. For each Trial a separated file will be created.

Events to Export

Select from the available events the ones that should be contained in export file 200.

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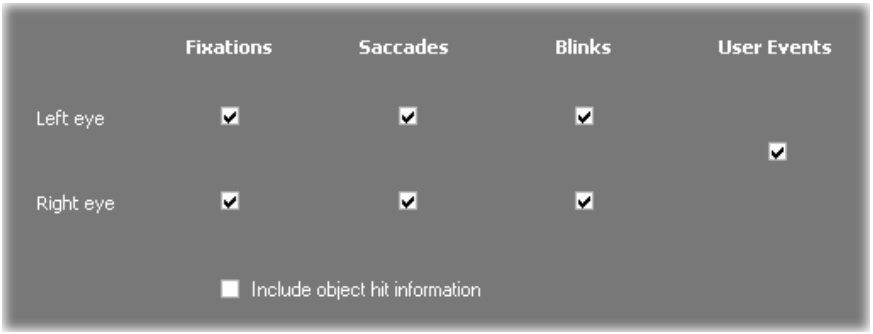


File Format

Configure the format of the export file 200.

Write Header

Select whether the Header 200 will be written in the file.

Decimal Places

Configure the format of the numerical values.

Separator

The separator between values can be one of the following:

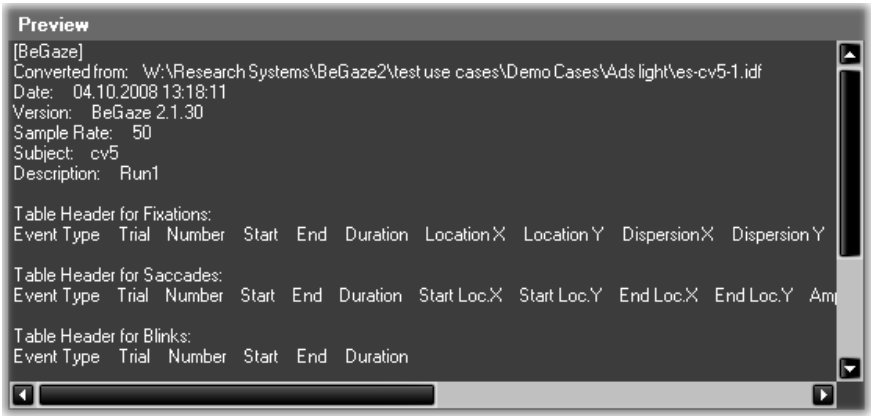
- Tab
- Space
- Comma
- Semicolon

Export Location

Click on to browse for the folder or to create a new folder. BeGaze 2.3 will create the file names automatically.

Preview

You can preview the exact format of the export file. Note: in trial section, only a few data lines are shown.


Preview
[BeGaze]
Converted from: W:\Research Systems\BeGaze2\test use cases\Demo Cases\Ads light\es-cv5-1.idf
Date: 04.10.2008 13:18:11
Version: BeGaze 2.1.30
Sample Rate: 50
Subject: cv5
Description: Run1
Table Header for Fixations:
Event Type Trial Number Start End Duration Location X Location Y Dispersion X Dispersion Y
Table Header for Saccades:
Event Type Trial Number Start End Duration Start Loc.X Start Loc.Y End Loc.X End Loc.Y
Table Header for Blinks:
Event Type Trial Number Start End Duration

The Export file may include information about:

- the start and the end time of the fixation, the fixation duration.
- the gaze coordinates at the beginning of the fixation.

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- the dispersion during the fixation in [pixels]
- the object hit during the fixation
- the amplitude of a saccade
- the maximum speed and acceleration of the saccade and the time when these maxima occurred

In case the experiment 229 contains head tracking data, additionally will be exported:

- the image name connected to a plane during a fixation on this plane
- the plane number during a fixation on it

8.2.2 Export File Format

8.2.2.1 Export File Format

The BeGaze 2.3 export file starts with a short header 200 section, followed by the trial section 201.

The file can be opened and read with any text editor, but as the entries are tab limited, it will be best read with a spreadsheet program like Microsoft Excel or similar.

8.2.2.2 Header

The header consists of the following few lines:

Converted from:	**Complete path of the IDF file.**
Date:	Date and time of the export.
Version:	Version, with which the export file is created.
Sample Rate:	Sample rate of the recording.
Subject:	Subject as written to IDF file or modified in experiment creation.
Description:	Description of Run as written to IDF file or modified

Converted from:	Complete path of the IDF file.
	in experiment creation.

8.2.2.3 Trial Section

The table header description is followed by the list of events.

Every event type has a different table header.

Event Export Fixations

The table header for fixations applies for all lines starting with the word Fixation.

The table headers mean the following:

Event Type:	fixation, L for left or R for right
Trial:	number of current trial
Number:	index of current fixation
Start:	start time in microseconds, relative to start time of beginning of the current trial
End:	end time in microseconds, relative to start time of beginning of the current trial
Duration:	duration of fixation in microseconds
Location X:	horizontal location of fixation in pixel on calibration area
Location Y:	vertical location of fixation in pixel on calibration area
Dispersion X:	horizontal dispersion of fixation in pixel
Dispersion Y:	vertical dispersion of fixation in pixel
Object hit:	name of area of interest (AOI) that is hit by current

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	fixation. The field could be '-', if no AOI is hit.

Event Export Saccades

The table header for saccades applies for all lines starting with the word Saccade.

The table headers mean the following:

Event Type:	saccade, L for left or R for right
Trial:	number of current trial
Number:	index of current saccade
Start:	start time in microseconds, relative to start time of beginning of the current trial
End:	end time in microseconds, relative to start time of beginning of the current trial
Duration:	duration of saccade in microseconds
Start Pos X:	horizontal start position of saccade in pixel on calibration area
Start Pos Y:	vertical start position of saccade in pixel on calibration area
End Pos X:	horizontal end position of saccade in pixel on calibration area
End Pos Y:	vertical end position of saccade in pixel on calibration area
Amplitude:	length of saccade in degrees
Peak Speed:	maximum speed of eye movement during current saccade
Peak Speed At:	location of speed maximum in parts of complete amplitude (a value of 0.416 means peak speed reached at 41.6% of amplitude)
Average Speed:	average velocity of current saccade in degrees per

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	second
Peak Accel.	maximum acceleration of current saccade in deg/s2
Peak Decel.:	maximum deceleration of current saccade in deg/s2
Average Accel.	average acceleration of current saccade in deg/s2

Event Export Blinks

The table header for blinks applies for all lines starting with the word Blink.

The table headers mean the following:

Event Type:	blink, L for left or R for right
Trial:	number of current trial
Number:	index of current blink
Start:	start time in microseconds, relative to start time of beginning of the current trial
End:	end time in microseconds, relative to start time of beginning of the current trial
Duration:	duration of blink in microseconds

Event Export User Messages

The table header for user messages applies for all lines starting with the word Blink.

The table headers mean the following:

Event Type:	user message
Trial:	number of current trial
Number:	index of current user message

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Start:	start time in microseconds, relative to start time of beginning of the current trial
Description:	content of the message

Note, that the origin of the calibration area is always in the upper left corner.

8.3 Export Raw Data

8.3.1 Export Raw Data

In case you want to perform further evaluation with third party software, it is possible to export the raw data to a custom delimited table in ASCII text format.

If you click on the toolbar item or go to the Export menu and select Export raw data to file, a window will be displayed, containing the following tabs:

- General
- Preview

Trial selection

Select the Trials from the Experiment, whose Raw Data should be exported. For each Trial a separated file will be created.

Fields to Export

Select from the available events the ones that should be contained in export file 207.

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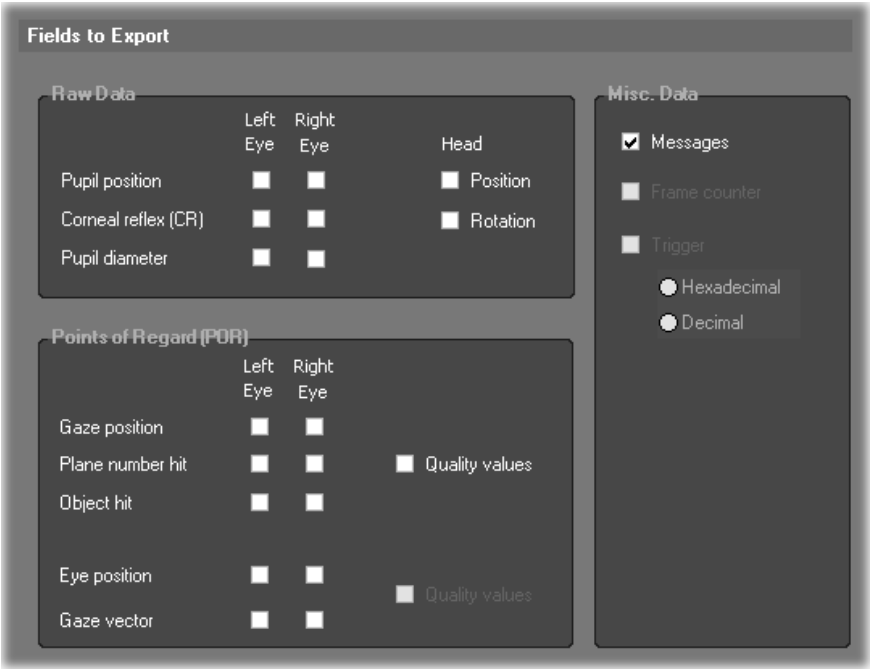

File Format

Configure the format of the export file 207.

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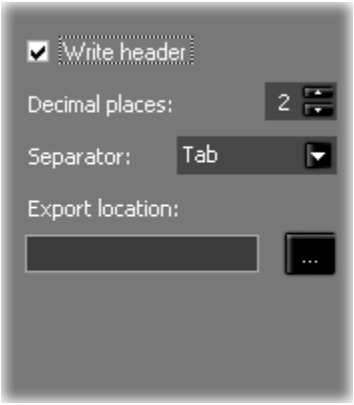

Write Header

Select whether the Header 208 will be written in the file.

Decimal Places

Configure the format of the numerical values.

Separator

The separator between values can be one of the following:

- Tab
- Space
- Comma
- Semicolon

Export Location

Click on ... to browse for the folder or to create a new folder. BeGaze 2.3 will create the file names automatically.

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Preview

You can preview the exact format of the export file. Note: in trial section, only a few data lines are shown.

Preview

```
## [BeGaze]
## Converted from:  W:\Research Systems\BeGaze2\test use cases\Demo Cases\Ads light\es-cv5-1.idf
## Date:  04.10.2008 13:28:39
## Version:  BeGaze 2.1.30
## Sample Rate:  50
## [Run]
## Subject:  cv5
## Description:  Run1
## [Calibration]
## Calibration Type:  9-point
## Calibration Area:  1280  1024
## [Geometry]
## Stimulus Dimension [mm]:  376  301
## Head Distance [mm]:  700
## [Hardware Setup]
## [Presentation]
## Number of Samples:  250
## Reversed:  none
## Format:  MSG
##
Time  Type  Trial
6961867180  MSG  1  # Message: image11.bmp
6961872225  SMP  1
6961898994  SMP  1
6961919298  SMP  1
6961942882  SMP  1
6961967586  SMP  1
```

8.3.2 Export Raw File Format

8.3.2.1 Export Raw File Format

The BeGaze 2.3 export file starts with a short header 208 section, followed by the trial section 208.

The file can be opened and read with any text editor, but as the entries are tab limited, it will be best read with a spreadsheet program like Microsoft Excel or similar.

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8.3.2.2 Header

The header consists of the following few lines:

Converted from:	Complete path of the IDF file.
Date:	Date and time of the export.
Version:	Version, with which the export file is created.
Sample Rate:	Sample rate of the recording.
Subject:	Subject as written to IDF file or modified in experiment creation.
Description:	Description of Run as written to IDF file or modified in experiment creation.
Calibration Type:	Type of calibration used during recording.
Calibration Area:	Width and height of the calibration area.
Stimulus Dimension:	Width and height of the stimulus.
Head Distance:	Distance between subject and stimulus during recording.
Number of Samples:	Number of samples in the exported trial.
Reversed:	Specifies whether the recorded values were reversed on horizontal and/or vertical axis.
Format:	Format of the exported fields.

8.3.2.3 Trial Section

The table header description is followed by the list of samples and messages.

Raw Data Export Samples

The following fields can be exported for one sample (if available):

Time:	Timestamp of the sample.
Type:	The type is SMP.
Trial:	Number of current trial.
L Raw X [px]:	Horizontal pupil position.
L Raw Y [px]:	Vertical pupil position.
L Dia X [px]:	Horizontal pupil diameter.
L Dia Y [px]:	Vertical pupil diameter.
L CR1 X [px]:	Horizontal corneal reflex position. One or two CRs can be present.
L CR1 Y [px]:	Vertical corneal reflex position.
L POR X [px]:	Horizontal gaze position
L POR Y [px]:	Vertical gaze position
Timing, Latency:	Quality values
L Plane:	Plane number
L Object Hit:	Name of area of interest (AOI) that is hit by current sample.
H POS X [mm]:	Head position on X
H POS Y [mm]:	Head position on Y
H POS Z [mm]:	Head position on Z
H ROT X [°]:	Head rotation on X
H ROT Y [°]:	Head rotation on Y
H ROT Z [°]:	Head rotation on Z
L EPOS X:	Eye position on X
L EPOS Y:	Eye position on Y
L EPOS Z:	Eye position on Z
L GVEC X:	Gaze vector on X

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L GVEC Y:	Gaze vector on Y
L GVEC Z:	Gaze vector on Z
Frame:	Frame counter

In case of binocular recordings, data from both channel (named L and R) can be exported.

Raw Data Export Messages

The following fields are exported for one message, along with the actual message:

Time:	Timestamp of the sample.
Type:	The type is MSG
Trial:	Number of current trial

Note, that the origin of the calibration area is always in the upper left corner.

8.4 Video Files

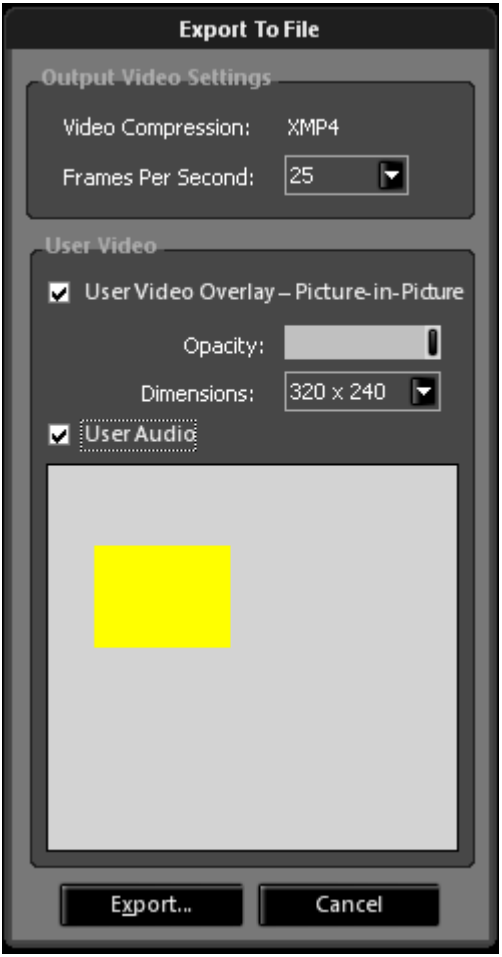
8.4.1 Video Export

You can record the animated **Attention Map** as well as the **Scan Path** or the **Key Performance Indicators** replays to an AVI file.

1. From the **Export** menu, select the **Export Scan Path Video, Export Attention Map Video** or **Export KPIs Video** command.

   The **Export to File** dialog opens, where you can set the recording options and start the export.

2. Press **Export...**.



3. A popup dialog appears allowing you to select the desired video file name and location. Click "Save" to finish.

Dialog Settings

- **Video Compression**: Shows that the “XMP4” video encoder is used. Note, that you need to install this codec from the product installation

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CD.

- **Frames per second**: This setting applies to a still image stimulus. In case of a video stimulus, the stimulus' frame rate will be adopted. Select the number of frames per second for the exported AVI video. You can select 25 or 50 fps.

For experiments that contain user videos (user data recorded with a webcam) several other options are available. If no used data exists the **User Video** options are grayed out.

- **User Video Overlay**: If checked the user video is overlayed as a smaller image (picture-in-picture style) inside the animated data visualization.
  - **Opacity**: Selects the opacity level of the user video. Moving the slider to the left fades out the user video more.
  - **Dimensions**: Size of the user video to embed in the main video.
- **User Audio**: If checked the sound from the user video is used as the sound for the exported AVI (if the stimulus is a video with sound then this setting replaces the stimulus sound with the user sound)
- **User Video Location**: The yellow rectangle can be dragged on the gray surface to set the position of the user video relative to the main video in the exported AVI.

8.4.2 Optimizing AVI Videos

The real-time video display and edit functions require appropriate computing resources. While it is necessary to use a modern and powerful PC, it is possible to optimize video data for use with BeGaze 2.3. The video file conversion described below will give a faster response while editing AOIs and working with the video data during analysis.

All video streams are stored as a sequence of single images. To save disk space or transport bandwidth, the following techniques are used:

- The stored image frames are compressed, which normally means that an algorithm is used to encode and decode the single image frames.

Most of the image codecs (“Coder/Decoder”) will discard visible information for better compression. There is a tradeoff between file size and visible details.

- If you store images frame after frame, the resulting file size is huge even if the frames are compressed. For this reason, only some frames are stored completely – as “key frames”. All frames following a key frame are generated based on the key frame with additional transformations applied. A high compression video codec will insert key frames only, if it detects major scene changes in the base material. While this is fine for sequential watching, stepping some frames backward requires a lot of calculation. There is also a tradeoff between file size and necessary CPU resources.
- To optimize the user experience for the standard use case “watching the video”, post-processing is applied while reading the video file and displaying it’s contents on the screen. This includes for example to sharpen the video, video scaling or de-interlacing TV material for a non-interlaced computer monitor. There is a tradeoff between screen rendering quality and CPU resources.

BeGaze 2.3 works best with the customized Xvid Solutions MPEG-4 codec (XMP-4) installed during BeGaze 2.3 setup. The post-processing configuration for this codec, which is also applied during setup, is optimized for editing and analyzing purposes. You should convert your video material to this codec and insert more key frames while doing so.

The XMP-4 codec is compatible to standard Xvid and DivX codecs for playback.

8.4.3 Converting Videos with SMI Video Optimizer

Videos are automatically converted while creating experiment in Experiment Center V2.3.

As an alternative, the SMI Video optimizer can be used to convert videos as well.

The SMI Video Optimizer converts (re-encodes) nearly every kind of

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video into our recommended XMP4 avi format with optimal codec settings.

The XMP4 codec is automatically installed and configured on the PC during the installation of Experiment Center and BeGaze.

Supported Video Formats

The video optimizer has been successfully tested with a huge variety of video formats and codecs, including DVD (vob), MPEG and Flash (flv) videos.

Nevertheless it depends on the installed and licensed codecs if the selected videos can be converted.

The Video Optimizer is using Microsofts Direct X interface to read and convert the selected videos. Please ensure that you have all codecs licensed and installed that your original video needs in order to be read.

Open Video Optimizer

Click on the Video Optimizer entry in the start menu under All Programs -> SMI -> Experiment Suite 360° -> Tools -> Video Optimizer to execute the program.

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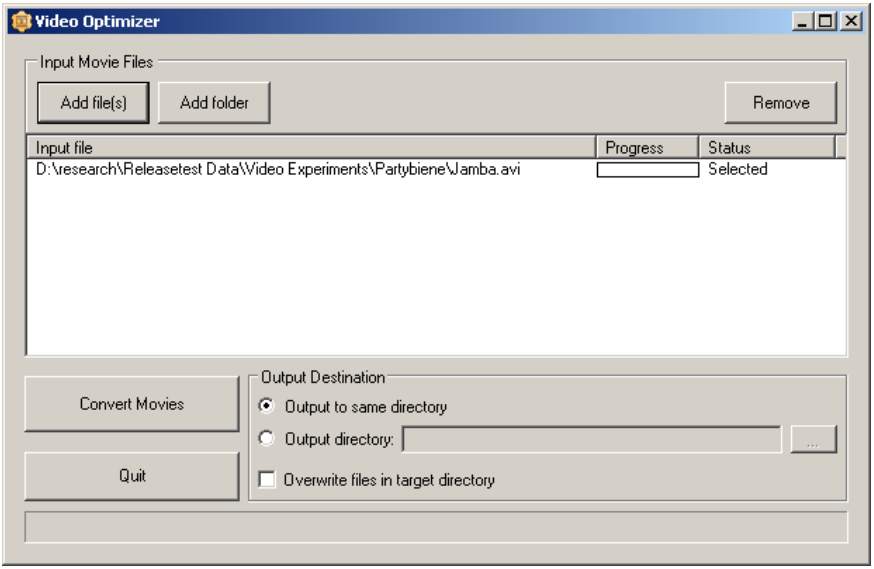

Adding Videos

1. Click on the buttons **Add file(s)** or **Add folder** to add the videos you want to re-encode.
2. You can also add files by drag&drop of video files from programs like the Windows Explorer into the **Input file** area of the Video Optimizer.

Convert Videos

Press the **Convert Movies** button to start the re-encoding of your videos.

Please note that the new video files are renamed. The re-encoded videos are saved as Originalname + "(optimized).avi"

Original AVI file are not overwritten, please rename the converted video if necessary.

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8.4.4 Background Information

The AVI (“Audio Video Interleaved”) container file format is highly suitable for editing purposes. The file format was invented in the 1990’s, with the developing focus on CPU resources with no copy/edit protection nor internet distribution in mind. One of the major drawbacks of this format is the CBR (“Constant Bit Rate”) audio support. It is possible to add VBR (“Variable Bit Rate”) audio material – but this violates the original format specification which may trigger viewer incompatibilities. VBR audio is used most likely for internet video or converted DVD material while self-recorded material usually has CBR audio. If you experience audio dropouts or audio-lag, you can extract the audio file from the AVI file, convert the audio using a CBR codec and re-include the CBR audio to a new AVI file. Another option is to use a special version of VirtualDub called “Nandub” for writing an AVI with VBR audio.

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Workspace Reference

Chapter

9 Workspace Reference

9.1 Menu Commands

The following gives an overview of the menu commands:

File

New Experiment...	Starts the Create Experiment wizard 26 to create a new experiment
New Experiment from Folder...	Creates an experiment on the basis of a results folder which has been created with the SMI Experiment Center
Open Experiment...	Opens a dialog box to select a saved experiment from the database 230
Close Experiment	Closes the current experiment
Save Experiment	Saves the current experiment to the database 230
Save Experiment As...	Saves the current experiment as a new experiment in the database 230
Modify Experiment...	Opens the Modify Experiment wizard 39, where all parameters used to create an experiment can be changed
Adjust Event Detection...	Opens the dialog to change and edit the event detection parameters
Delete Experiment from Database...	Opens a dialog to delete a saved experiment from the database 230
Backup Experiment to File...	Opens a dialog to select a saved experiment from the database 230. A backup of the selected experiment will be created in a file.
Restore Experiment from File...	Opens a file selection dialog to select

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	and restore an experiment from file
Print Preview	Opens the print preview
Print...	Opens the printing dialog
Change Data Storage Location...	Opens a folder selection dialog to select another location for the database 230
Reset Plugin Detection	On the next run of BeGaze 2.3, the available data views will be dynamically detected
Recent Experiments	Opens a sub menu with the last opened experiments
Quit	Closes BeGaze 2.3

View

Close Selected View	Closes the selected view
Close All	Closes all opened views
Close All but Selected View	Closes all the views except selected one
Toolbar	Toggles activation/deactivation of the toolbar 221

Analysis

AOI Editor	Opens the AOI Editor 68 data view
Line Graph	Opens the Line Graph 93 data view
Scan Path	Opens the Scan Path 104 data view
Attention Map	Opens the Attention Map 114 data view
Key Performance Indicators	Opens the Key Performance Indicators 121 data view
AOI Sequence Chart	Opens the AOI Sequence 128 data view
Binning Chart	Opens the Binning Chart 132 data view

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Event Statistics	Opens the Event Statistics 134 data view
Reading Statistics	Opens the Reading Statistics 168 data view

Export

Export Scan Path Video / Export Attention Map Video / Export KPIs Video	Exports the currently displayed scan path, attention map or kpis to a video file. These Menu commands are available only if the corresponding data views are activated.
Save Image to File...	Saves the graph/chart from the currently selected view to an image file. The following file formats are supported: BMP, JPG, PNG.
Copy Image to Clipboard	Copies the graph/chart from the currently selected view to clipboard. Afterwards, it can be pasted into other third party applications.
Export Raw Data to File...	Opens the **Raw Data Export** dialog, which allows the creation of text files from the raw data of an experiment
Export Event Data to File...	Opens the **Event Export** dialog, which allows the creation of text files from the computed event data of an experiment

Help

Help Topics	Opens this manual
About BeGaze 2.3	Shows general information about BeGaze 2.3 (see About Box 227)

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9.2 The Toolbar

The toolbar is at the top of the workspace. It gives you short-cuts to important features.

Here is an overview of the buttons and its meanings:

General buttons

Starts the Create Experiment wizard 26 to create a new experiment for standard data

Opens a dialog to select an existing experiment

Saves the current experiment

Prints the current diagram.

Opens a dialog to remove existing experiment(s)

Diagram selection

Line Graph 93: displays x and y directions of gaze data plotted as graphs over time and events displayed in a timeline

Scan Path 104: displays gaze data overlay over the stimulus image

Attention Map 114: shows gaze patterns over the stimulus image visualized as **Heat Map** or **Focus Map**

Key Performance Indicators 121: displays relevant statistical data for each defined AOI over the stimulus image

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AOI Sequence Chart 128: displays AOI hit order over time

Binning Chart 132: gives a statistical overview of AOI hits per binning frame

Event Statistics 134: computes diverse statistics based on events and AOI hits

Reading Statistics 168: computes diverse statistics based on events and AOI hits on text for reading experiments

Export buttons

Opens a dialog that allows to export raw data to file

Opens a dialog that allows to export events to file

Other commands

Opens the AOI Editor 68

9.3 Hotkeys Overview

Several functions of BeGaze 2.3 can be executed using keyboard commands. The following tables give you an overview.

General keyboard commands

Keys	Description
[CTRL] + [O]	opens a dialog box to select a saved

Keys	Description
	Experiment from the Database 230
[CTRL] + [W]	closes the view of the selected data view
[CTRL] + [SHIFT] + [W]	closes all views of opened plug-ins
[CTRL] + [B]	closes all views of opened data views but selected one
[CTRL] + [G]	saves current settings globally
[CTRL] + [E]	saves current settings for the current experiment
[CTRL] + [C]	copies selected diagram to clipboard, so it can be pasted into other third-party applications
[CTRL] + [S]	saves selected diagram to an image file
[F1]	opens this help file
[CTRL] + [X]	opens and closes the stimuli selection
[CTRL] + [TAB]	steps forward through the data view tabs
[CTRL] + [SHIFT] + [TAB]	steps backwards through the data view tabs
[CTRL] + [MOUSEWHEEL]	only when zoom 63 is available: zooms in and out

AOI Editor 68 keyboard commands

Keys	Description
[DEL]	deletes selected AOIs
[HOME]	jumps to first key frame

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[END]	jumps to last key frame
[PG Up]	goes to next key frame
[PG Dn]	goes to previous key frame
[CTRL] + [Z]	undo action
[CTRL] + [Y]	redo action
[V]	toggles the visibility of the selected AOI
[D]	deletes current keyframe
[SHIFT] + [MOUSEWHEEL]	changes the size of a selected AOI

Video keyboard commands

The following keyboard commands are available to navigate in a video (see Player Control 61). They are available in the AOI Editor 68, Scan Path 104, Attention Map 114 and Key Performance Indicators 121 data views.

Keys	Description
[SPACE]	plays/pauses the presentation
Right arrow key	moves presentation one step forward according to the selected step size
Left arrow key	moves presentation one step backward according to the selected step size
Arrow up key	increases the step size
Arrow down key	decreases the step size
[CTRL] + [HOME]	jumps to the begin of the trial resp. the selected time window
[CTRL] + [END]	jumps to the end of the trial resp. the selected time window
[B]	set and resets a bookmark

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[CTRL] +	arrow	left	jump to previous bookmark
[CTRL] +	arrow	right	jump to next bookmark

Line Graph 93 keyboard commands

Keys	Description
Left arrow key	moves selected time cursor to the left
Right arrow key	moves selected time cursor to the right

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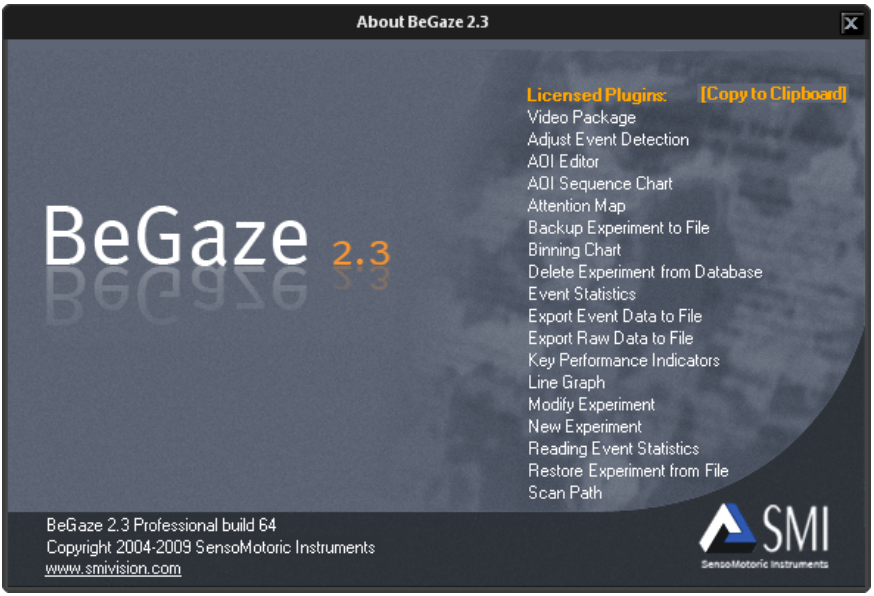
Appendix

Chapter

10 Appendix

10.1 About Box

To get general information about BeGaze 2.3 go to the Help menu of the Menu Commands 218 and select About BeGaze 2.3.



- BeGaze 2.3 Version: The line displays the current version number.
- Copyright: The line displays copyright information.
- Home Page: Here you can visit our home page.
- Licensed data views: BeGaze 2.3 is licensed to one computer only. Here you can see a list with all licensed data views.
- Copy to Clipboard: In a service case please click here to copy to clipboard detailed information about each licensed data view and report this to the customer support and service team of your local

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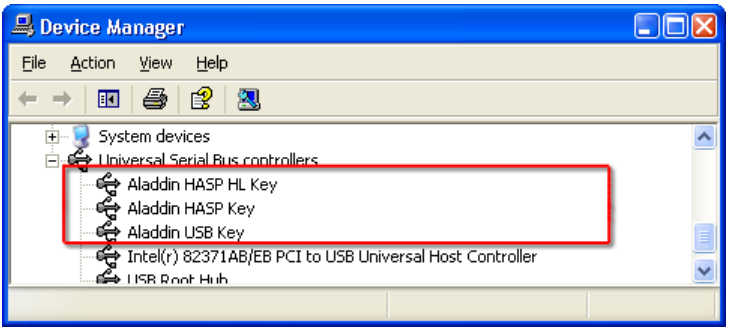
distributor or SMI 244.

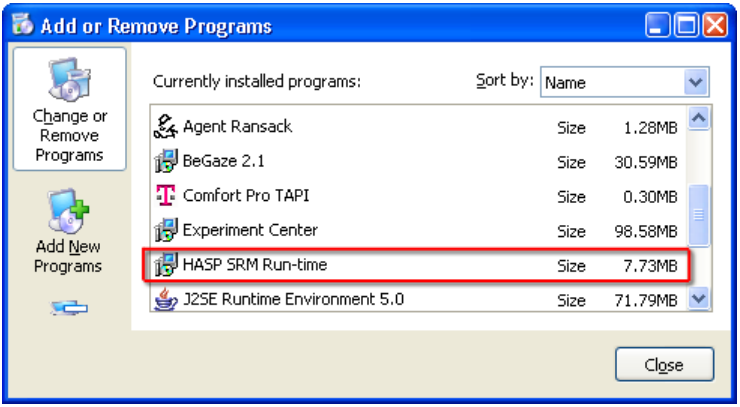
10.2 Dongle - Installation and Troubleshooting

BeGaze 2.3 is dongle-protected. You may have to place the USB-dongle in the appropriate PC before you can start the program. If BeGaze 2.3 displays a message box stating **HASP SRM Protection System**: **The software requires a hardware key (dongle)**, check the following:

1. The activity LED of the USB-dongle should show a red light if the dongle is plugged in.
2. If the activity LED does not show a red light, check the USB port status in the Windows hardware settings dialog. Open the Windows **Control Panel** and double click the **System** icon. Switch to the **Hardware** tab and click on the **Device Manager** button. Verify, that the **Universal Serial Bus controllers** tree does not show any yellow warning signs ( ). The screen shot below shows a functional USB port with a correct Windows driver installation.



   If the dialog displays a warning sign ( ) for a driver, right click the entry and select the **Update Driver...** command from the context menu.
3. Verify, that the dongle driver is installed properly. Open the Windows **Control Panel** and double click the **Add or Remove Programs** icon. Check if the list shows the **HASP SRM Run-time** entry.



Note, that the **HASP SRM Run-time** is installed during the installation of BeGaze 2.3. Do not deny the installation of this software during installation when prompted.

Type and status of your licenses are stored on the dongle device, not on the PC on which BeGaze 2.3 is installed. With the license update procedure, the dongle is updated. That means, that you can run BeGaze 2.3 on any PC when the dongle is plugged in.

10.3 Experiment Types

The eye tracking experiments fall into two major groups:

- experiments with eye tracking data (standard data)
- experiments with eye tracking and head tracking data

Dependent on the type of experiment the way data is collected differs slightly.

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10.4 Database

All BeGaze 2.3 experiments will be collected in a database. Once you imported the data files, images and AOI files in BeGaze 2.3, you will no longer have to keep in mind the location of these files as they are stored bundled in the database.

The path where the database is located can be changed by going to the **File** menu and selecting **Change Data Storage Location**.

Initially, the database is located in the user's data folder. This corresponds to "Application Data" folder in Windows XP and "AppData \Roaming" folder in Windows Vista. For example, if your computer is running Windows XP and your user name is "BegazeUser", the complete path to the database will be: C:\Documents and Settings\BegazeUser \Application Data\SMI\BeGaze 2\BeGaze 2 Data Base.

If more users decide upon sharing the data base, they should change data storage location to a local folder where all have enough security rights.

Due to performance and concurrent access issues, a common network folder should not be used.

Note that the Change Data Storage Location menu command is available only if all experiments are closed.

10.5 Requirements

Hardware requirements

BeGaze 2.3 should be installed on a personal computer or laptop with the following minimum requirements:

OS:	Windows XP Service Pack 2/Windows Vista
CPU:	AMD or Intel Dual Core with 2 GHz

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RAM: minimum 1 GB

VGA: 3D accelerated, 512 MB RAM, DirectX 9 Compatible, OpenGL V1.2 compatible

HDD: at least 10 GB of free hard disk space

For best views the monitor should be of size 17" or bigger with a minimum resolution of 1280x1024 pixels.

For database backups a DVD writer is recommended.

Some functions of BeGaze 2.3 need a printer connected.

Graphic card compatibility with OpenGL

BeGaze 2.3 is using OpenGL functionality in order to achieve best performance. The graphic card needs to be compliant with the OpenGL standard V1.2. Unfortunately not all graphic card drivers fully support this OpenGL standard. This might result in corrupted visualizations in the scan path, attention map views.

We recommend to use a OpenGL V1.2 compliant graphic card or, as a workaround, to disable the Hardware acceleration in the Windows graphic card settings.

Please contact the SMI support for a positive/negative list of graphic cards.

The OpenGL version can be verified with the Extension Viewer from RealTech VR:
http://www.realtech-vr.com/glview/index.html

10.6 Limits

SMI guarantees BeGaze to work within the following limits:

Max. number of stimuli in one experiment	250
Max. number of trials per stimuli	250

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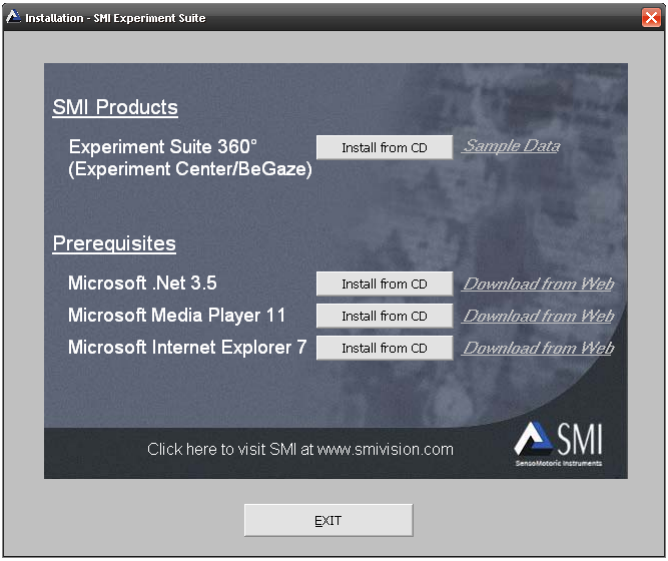
Max. length of video / max. number of videos	2h / 5
Max. length of video / max. number of videos	1min / 200
Max. number of subjects per experiment	200
Max. length per trial / max. number of stimuli	2h / 5
Max. length per trial / max. number of stimuli	10min / 200
Max. number of AOIs per stimulus	250

10.7 Program Installation

The product installation media (CD-Rom) offers suitable software packages to install. Please run the auto-start application from the installation medium and click on the respective buttons to install necessary software.



The Experiment Suite 360° includes the BeGaze 2.3 as well as the

Experiment Center 2.3 software. To install the Experiment Suite 360°, proceed as follows:

1. Insert the installation media (CD-Rom).

   The auto-start application opens.

2. Click on the **Install from CD** button.

   Follow the steps of the installation wizard.

While installing the Experiment Suite 360°, the USB dongle driver (HASP SRM Run-time) is installed or updated. You may need to update the USB dongle license information. Refer to Dongle Protection and License Update 12 for details.

The Microsoft .NET Framework, the Microsoft Internet Explorer, and the Microsoft Media Player software components are available from the BeGaze 2.3 installation media. These software components are also available from the Microsoft web site where you can download them for installation to the desired PC workstation. Both software components will inspect your PC workstation during installation and may issue warning messages if the PC resources do not meet the necessary performance.

Please use always the latest versions that are available for download from the Microsoft web site.

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Chapter

11 Copyright and Trademarks

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Chapter

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Teltow, Germany, 2004-2009
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About SMI

Chapter

13 About SMI

SensoMotoric Instruments (SMI) is a world leader in dedicated computer vision applications, developing and marketing eye & gaze tracking systems and OEM solutions for a wide range of applications.

Founded in 1991 as a spin-off from academic research, SMI was the first company to offer a commercial, vision-based 3D eye tracking solution. We now have over 17 years of experience in developing application-specific solutions in close collaboration with our clients.

We serve our customers around the globe from our offices in Teltow, near Berlin, Germany and Boston, USA, backed by a network of trusted local partners in many countries.

Our products combine a maximum of performance and usability with the highest possible quality, resulting in high-value solutions for our customers. Our major fields of expertise are:

- Eye & gaze tracking systems in research and industry
- High speed image processing, and
- Eye tracking and registration solutions in ophthalmology.

More than 4,000 of our systems installed worldwide are testimony to our continuing success in providing innovative products and outstanding services to the market. While SMI has won several awards, the largest reward for us each year is our trusted business relationships with academia and industry.

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Index

- A -

About
- BeGaze 2.3 227
- Manual 4
- SMI 244

Adjust Event Detection 188
Analysis Menu 218
AOI
- Change Position 73
- Change Shape/Size 73
- Create 71
- Delete 86
- Edit 73
- Edit Properties 79
- Format Description 87
- Load 87
- Priority 73
- Rename 73
- Save 87
- Visibility 83

AOI Editor
- Key Frames 85
- Open 71
- Overview 68
- Toolbar 70

AOI Sequence Chart
- Main Pane 129
- Plug-in 128

Attention Map
- Main Pane 115
- Plug-in 114
- Settings 117
- Video Export 210

AVI, Optimizing 212

- B -

Backup Experiment 41
BeGaze 2.3 Version 227
Binning Chart
- Main Pane 133
- Plug-in 132

Built-In Detector 187

- C -

Chart Display Modes 67
Control Pane 61
Converting Video 213
Copyright 235
Cursor Tab, Scan Path 111
Cursors 98
Custom Map 115

- D -

Data Import 29
Details
- Events 58
- Subject 55

Diagrams 47
Dongle
- General Information 12
- Installation 228
- Troubleshooting 228

- E -

Event

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Event
Details 58
Detection, Experiment Wizard 35
Event Statistics
Overview 134
Selection Trees 135
Templates 137
Time Interval 139
Events
Export 197
Selection 57
Experiment
Backup 41
Close 41
Delete 44
Load from Folder 27
Menu 218
Modify 39
Open 40
Restore 43
Save 40
Experiment Wizard
Data Import 29
Event Detection 35
General Settings 28
Measurement Scenario 37
Signal 37
Stimuli 32
Stimulus Association 34
Export 208
Events 197
File Format 200
Menu 218
Overview 197
Raw Data 204
Raw File Format 207
Video 210

- F -

File Export 197, 200, 201, 207, 208
File Format
Export 200
Header 200
Raw File Format 207
Trial Section 201
File Menu 218
Filters, Subjects 52
Fixation
Detection 187, 191
Parameters 188
Fixations, Scan Path 113
Focus Map 115

- G -

General Settings, Experiment Wizard 28
Getting Started 20
Group Properties 52

- H -

Header, File Format 200
Heat Map 115, 117
Help Menu 218
High Speed Event Detection 193
Hotkeys 222
How BeGaze works 14

- I -

Installation 232

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Introduction 2

- K -

Key Features 8
Key Frames 85
Key Performance Indicators
  Main Pane 122
  Plug-in 121
  Settings 124
  Video Export 210

- L -

License
  Agreement 237
  Update 12
Line Graph
  Data 98
  Diagram Cursors 98
  Events 94
  Main Pane 96
  Miniview 99
  Plug-in 93
  Settings 100
  Time 98
Low Speed Event Detection 191

- M -

Main Pane
  AOI Sequence Chart 129
  Attention Map 115
  Binning Chart 133
  Key Performance Indicators 122
  Line Graph 96
  Scan Path 106
Manual 4
Measurement Scenario 37
Menu Commands 218
Modify, Experiment 39

- O -

Online Help 4
Optimizing, AVI 212

- P -

Peak Velocity Window 188
Playback Control 62
Player Control 61
Plug-in
  AOI Sequence Chart 128
  Attention Map 114
  Binning Chart 132
  Event Statistics 134
  Key Performance Indicators 121
  Line Graph 93
  Operating Panes 50
  Overview 46
  Panes Overview 49
  Scan Path 104
  Selection 47
Primary Event
  Fixation 191
  Saccade 193
Print Menu 218
Product Variants 11
Program
  Installation 232

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- R -

Raw Data Export 204
Raw File Format 208
Requirements 230
Restore, Experiment 43

- S -

Saccade
  Detection 187, 193
  Parameters 188
Scan Path
  Appearance 109
  Main Pane 106
  Plug-in 104
  Settings 109
  Video Export 210
Scan Path Settings
  Cursor Tab 111
  Fixations Tab 113
  Scan Path Tab 109
Selection
  Events 57
  Plug-in 47
  Subjects 52
Selection Trees, Statistics 135
Settings
  Attention Map 117
  Key Performance Indicators 124
  Scan Path 109
Shortcuts 222
Signal 37
Stimulus 32
  Assocication 34
  Selection 51
Subjects
  Details 55
  Filters 52
  Selection 52
System Requirements 230

- T -

Templates, Event Statistics 137
Thumbnail Control
  Context Menu 66
  Overview 64
Time Interval, Event Statistics 139
Toolbar
  AOI Editor 70
  Common 221
Trademarks 235
Trial Section
  File Format 201
  Raw File Format 208

- U -

Use Cases 17

- V -

Video
  Background Information 216
  Converting 213
  Export 210
  Optimizing 212
View Menu 218
VirtualDub 213
Visibility, AOI 83

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- W -

Wizard 26

- Z -

Zoom Control 63

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